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**SOCIOECONOMIC, PRODUCTIVE AND MANAGEMENT PROFILE OF
FISH FARMS IN THE EASTERN AMAZON¹**

**PERFIL SOCIOECONÔMICO, PRODUTIVO E DE MANEJO DE
PISCICULTURAS NA AMAZÔNIA ORIENTAL**

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ABSTRACT

Fish farming in the Salgado microregion, in the State of Pará (Brazil) is an important activity, contributing significantly to local subsistence and the economy, while presenting both challenges and opportunities. This study aimed to analyze the socioeconomic, production, and management characteristics of fish farming in the municipalities of Vigia de Nazaré and São Caetano de Odivelas. Structured questionnaires were applied to 16 fish farmers selected during *in loco* visits from October to November 2024, using the snowball sampling technique. The data regarding significant associations between variables related to the farming system, annual productivity, and annual production were analyzed using multiple correspondence analysis (MCA) in R software version 4.0.2. The results showed that most fish farmers are male, predominantly elderly, adopt an extensive system, rely predominantly on family labor, have low levels of education, retirement and agriculture are the main sources of livelihood, receive limited technical assistance, and primarily cultivate tilapia (*Oreochromis niloticus*). The analyses revealed that technical assistance and the species type cultivated are associated with higher productivity, highlighting the need for public policies and technical support to foster the growth of fish farming in the region. Factors that also underscore the importance of training, access to technology, and better resource management to enhance aquaculture.

Keywords: Aquaculture. Public policies. Sustainability.

RESUMO

A piscicultura na microrregião do Salgado, no Estado do Pará (Brasil), é uma atividade importante, contribuindo expressivamente para a subsistência e a economia local, apresentando tanto desafios quanto oportunidades. Este estudo teve como objetivo analisar as características socioeconômicas, produtivas e de manejo na piscicultura do município de Vigia de Nazaré e São Caetano de Odivelas. Foram aplicados questionários estruturados a 16 piscicultores selecionados em visitas *in loco* no período de outubro a novembro de 2024, através da técnica de amostragem Snowball sampling. Os dados das associações significativas entre as variáveis relacionadas ao sistema de criação, produtividade anual e produção anual foram analisados utilizando a análise de correspondência múltipla (MCA) no software R, versão 4.0.2. Os resultados mostraram que a maioria dos piscicultores são do sexo masculino, com

predominância de idosos, adotam o sistema de cultivo extensivo, com força de trabalho predominante familiar, apresentam baixa escolaridade, aposentadoria e agricultura são as principais fontes de sustento, recebem pouca assistência técnica e a tilápia (*Oreochromis niloticus*) é a espécie mais cultivada. As análises revelaram que a assistência técnica e o tipo de espécie cultivada estão associados à maior produtividade, destacando a necessidade de políticas públicas e apoio técnico para o crescimento da piscicultura na região. Fatores que também ressaltam a necessidade de capacitação, acesso a tecnologias e melhor gestão de recursos para alavancar a piscicultura.

Palavras-chave: Aquicultura. Políticas pública. Sustentabilidade.

INTRODUCTION

Aquaculture is a constantly expanding sector with great potential to consolidate itself in the global food production industry (Garlock et al, 2020). The global output of aquatic organisms in the aquaculture sector has increased substantially, reaching 130.9 million tons. In this context, continental fish farming stands out as the most important aquaculture segment based on production and global economic value (FAO, 2024).

According to Viana et al. (2022), projections indicate that by 2030, fish farming will provide 60% of all fish for human consumption. This increase represents remarkable growth compared to traditional fishing, surpassing it by 54%.

In Brazil, fish farming recorded a 3.1% increase in 2023, reaching 887,029 tons, despite the challenges faced by the sector due to climatic and sanitary conditions. This expansion reflects the efforts of producers who have contributed to the continuous growth of Brazilian fish farming (Peixe BR, 2024).

With the highest per capita consumption of aquatic organisms in Brazil, the Northern region shows a high demand for fish, which is not fully met by extractive fishing. In this scenario, continental fish farming emerges as a strategic alternative to supply the region's demand while positively impacting local employment and income generation (Brabo et al, 2017; Feitosa et al, 2019).

In 2023, fish farming in the state of Pará reached a production of 25.1 thousand tons, ranking 13th nationwide (Peixe BR, 2023). Despite its potential, aquaculture still faces challenges that hinder its full development, such as a lack of skilled labor, insufficient technical assistance, inadequate management

practices, high production costs, and deficiencies in data collection and analysis regarding production and marketing. As a result, the quality of the farmed fish is adversely affected (Schreiber et al, 2021).

Despite these challenges, fish farming is on the rise in the state of Pará, with a growing number of family-based entrepreneurs engaged in the activity (Silva et al, 2020a). However, there remain knowledge gaps regarding the characteristics of fish farms developed in the Eastern Amazon, especially in the municipalities of Vigia de Nazaré and São Caetano de Odivelas.

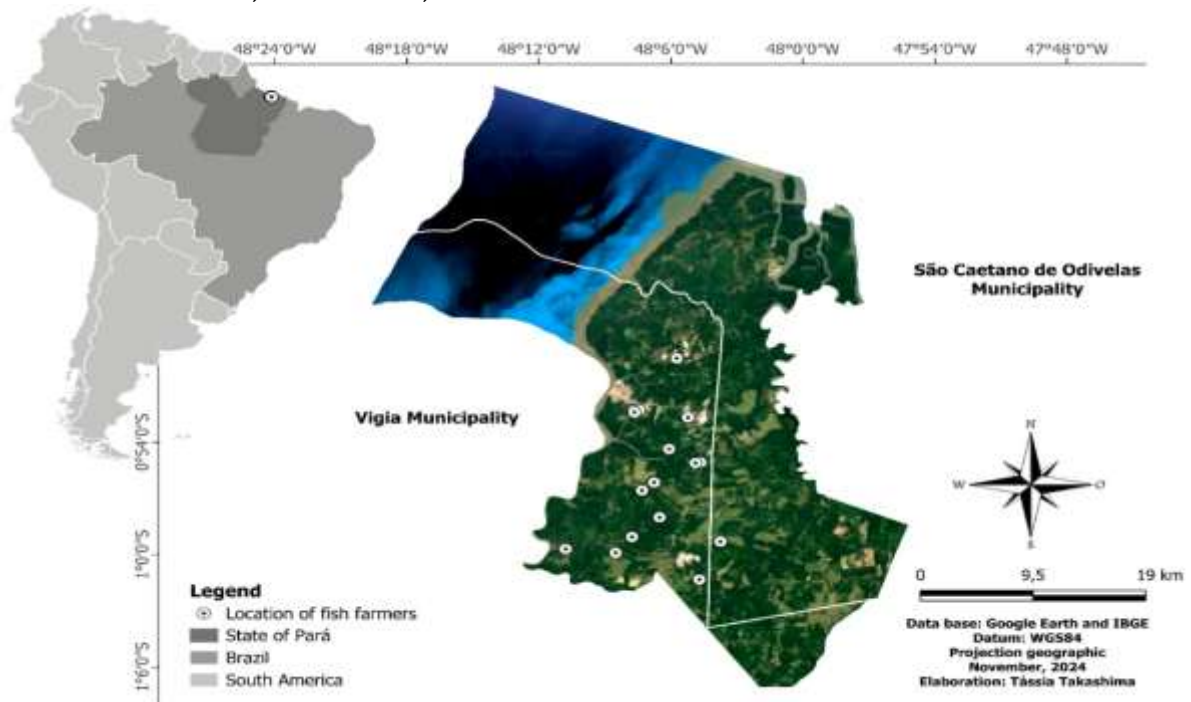
In this context, the present study aimed to analyze the socioeconomic, productive, and management profile of fish farms in the Eastern Amazon.

MATERIAL AND METHODS

Study Area

The study was conducted in fish farms located in the municipality of Vigia de Nazaré and São Caetano de Odivelas, both located approximately 77 km from the capital of Pará, in the Eastern Amazon. In Vigia de Nazaré, the study included the communities of Água Clara, Coração de Jesus, Cumarú, Itapuá, Km 32, Km 43, Penha Longa, Quatro Marcos, Tujáu, Santa Maria do Guarimã, São Sebastião do Guarimã, and Vila Acapú. In São Caetano de Odivelas, the focus was on Meratauá. These municipalities have populations of 50,832 and 16,666, respectively (IBGE, 2022).

Figure 1: Geographic location of fish farms in the municipalities of Vigia de Nazaré and São Caetano de Odivelas, State of Pará, eastern Amazon.



Source: Authors (2024).

Target Audience

The research involved sixteen fish farmers from the Salgado Paraense Microregion. The non-probabilistic snowball sampling technique was used to select the individuals (Penrod, 2003), in which each participant referred others, thus facilitating the collection of information needed to reach new fish farmers (Côelho et al., 2020). The study was approved by the Comitê Nacional de Ética em Pesquisa (CONEP), under protocol number CAAE: 83504824.9.0000.5173. All fish farmers participated voluntarily and signed the Informed Consent Form (IC).

Data Collection

The socioeconomic, production, and management profile of fish farmers was assessed using a structured questionnaire with closed-ended questions (Table 1) and by on-site observations at their properties performed during October and November 2024.

Table 1: Question groups used in the questionnaire to assess the socioeconomic, production, and management profile of fish farmers in the municipalities of Vigia de Nazaré and São Caetano de Odivelas, State of Pará, eastern Amazon.

Question groups	Topics	Questions description
Group A	Fish farmer identification	Sex, age, education level, and type of income source.
Group B	Characterization of fish farming/production	Activity purpose, flooded area, professional training, commercialization, labor, fingerling acquisition, annual average productivity, annual average production, and farmed species.
Group C	Fish farming management	Feeding type, technical assistance, storage, adequate pond facilities, and production system.

Source: Authors (2024).

Data Analysis

Initially, data on the fish farmers' profiles were analyzed using descriptive statistics (Zar, 1999). Subsequently, multiple correspondence analysis (MCA)

was applied to explore how fish farmers’ production systems, annual productivity, and annual production relate to socioeconomic, production, and management factors. This analysis is a statistical technique used to identify and represent patterns of association within a dataset. The results were presented in graphs, where each category of a variable is represented as points. The distance between these points reflects the relationships among the analyzed variables, and understanding these relationships requires knowledge of how the distances are determined (Greenacre, 1981). The MCA was performed using the Factoextra and FactoMineR packages in the R software (version 4.0.2; R Core Team, 2020).

RESULTADOS E DISCUSSÃO

According to the data in Table 2, the majority of the sixteen fish farmers interviewed are male (75%), over 60 years old (43.75%), and have not completed primary education (50%).

Table 2: Socioeconomic, production, and management profile of fish farmers in the municipalities of Vigia de Nazaré and São Caetano de Odivelas, State of Pará, eastern Amazon.

Category	Absolute frequency (N)	Relative frequency (%)
Sex		
Male	12	75.00%
Female	4	25.00%
Age		
40 – 50	5	31.25%
50 – 60	4	25.00%
> 60	7	43.75%
Education level		
Incomplete elementary education	8	50.00%
Elementary education	3	18.75%
Secondary education	4	25.00%
Undergraduate	1	6.25%
Labor type		
Hired labor	3	18.75%
Hired / family labor	2	12.50%
Family labor	11	68.75%
Farmed species		
Tambaqui	3	18.75%
Tilápia	10	62.50%
Tambaqui / Tilápia	2	12.50%
Tambaqui / shrimp	1	6.25%
Income source		
Agriculture	2	12.50%
Retirement	4	25.00%
Retirement / Agriculture	4	25.00%
Agriculture / private sector / fish farming	1	6.25%
Agriculture / Commerce	1	6.25%
Agriculture / Retirement / Fish farming	1	6.25%
Commerce	1	6.25%

Commerce / Retirement	1	6.25%
Commerce / Private sector	1	6.25%
Feeding type		
Commercial feed	13	81.25%
Commercial and alternative feed	3	18.75%
Production systems		
Semi-intensive	2	12.5%
Extensive	14	87.5%

Source: Authors (2024).

Gender disparity raises important issues related to sociocultural influences in fish farming, where the activity is associated with strength and physical labor typically attributed to men, resulting in limited female participation. Similar results were found in the study by Takahashi et al. (2020), which showed that most fish farmers in Jaguaribara, Ceará (Brazil), were male (89%).

Fish farming in Vigia and São Caetano de Odivelas is predominantly carried out by older adults who see potential in fish farming for the future, mainly through its continuation by future generations within their families. Hungria et al. (2024), in a study conducted in Vigia involving inactive fish farms, also identified evidence of an aging rural population that affects the dynamics of rural life. Such a trend is linked to the migration of younger generations to urban centers in search of better employment and educational opportunities, reflecting a general disinterest in continuing fish farming activities (Ximenes et al, 2025).

Regarding education level, fish farmers reported that limited access to education, combined with the demands of subsistence farming, contributed to school dropout. Trombeta et al. (2020) highlight that the lack of education represents a limiting factor for the integration of new technologies and management strategies into fish farming in Monte Alegre, Pará (Brazil), which negatively impacts the development of the activity in the region. This is also the reality for fish farmers in the municipality of Breves, in the Marajó Archipelago, where 52% of them are illiterate (Silva et al, 2020b).

Family labor is the predominant type of labor among fish farmers in Vigia and São Caetano de Odivelas (68.75%). This pattern is commonly observed in fish farms located in the northern region of Brazil (Sousa et al, 2019; Nakauth et al, 2015) and in seasonal fish farms across various localities in the country (Lima et al, 2018). All of these studies point to a strong reliance on family labor, considering it a key component in both the daily tasks execution and operation management. The strong presence of family labor reflects the traditional character of aquaculture as a family-run activity, where family members are deeply involved in daily tasks. It also highlights the limited financial resources to hire workers.

In this study, when asked about the farmed species, the majority of participants (62.5%) reported that Nile tilapia (*Oreochromis niloticus*) is the most commonly cultivated species. These results can be attributed to multiple factors, including the species' adaptability to local farming conditions, high reproductive rate, market demand, ease of handling, and overall feasibility (Li et al, 2024; Vieira et al, 2005). Factors that also contribute to the diversity of production systems, socioeconomic dynamics, and structural aspects of the tilapia value chain in Brazil (Flores et al, 2022).

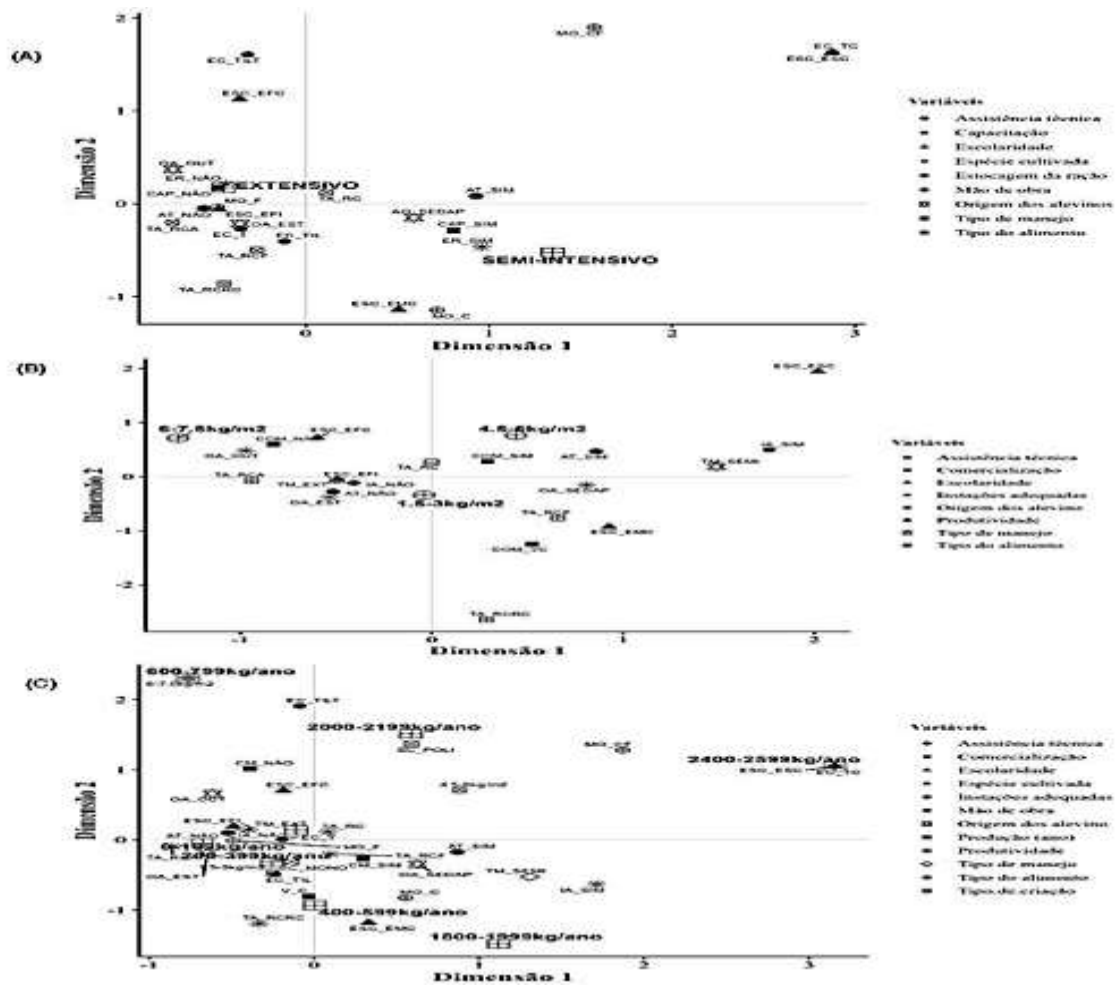
The majority of participants (87.5%) adopted the extensive farming system. According to small-scale farmers, this approach is preferred because of its lower costs and minimal infrastructure requirements. Consistent with these findings, Oliveira (2022) also observed that small-scale producers tend to use low-cost production systems for fish farming.

Regarding income sources, 50% of the participants depend on agriculture and retirement as their primary sources of income. This evidence was also observed by Côelho et al. (2020) when analyzing the fish production sector in the municipality of Alenquer (state of Pará, Brazil), concluding that fish farming is not the primary source of income in the region. Supporting this, Agbekpornu et al. (2019) found that fish farmers diversified their income sources by engaging in various economic activities beyond fish farming.

This study also highlights that, among the fish farms analyzed, the main type of feed used was commercial feed (81.25%). Similar results were reported by Gomes et al. (2020), who assessed fish farms in the Western Lowlands of Maranhão, Brazil, where fish were exclusively fed commercial feed to maintain product quality.

The multiple correspondence analysis (MCA) revealed associations between farming systems, productivity, and annual production with the socioeconomic, production, and management characteristics of the fish farms analyzed. These associations are illustrated in Figure 2.

Figure 2: Multiple correspondence analysis of the variables with the production system (A), annual productivity (B), and annual production (C). Variable abbreviations: Labor – hired (MO_C), hired and family (MO_CF), family (MO_F); Farmed species – tambaqui (EC_T), tambaqui and shrimp (EC_TC), tilapia (EC_TIL), tilapia and tambaqui (EC_TILT); Fry origin – state (OA_EST), others (OA_OUT), SEDAP (OA_SEDAP); Feed types – commercial feed and fruits (TA_RCF), commercial feed (TA_RC), commercial and alternative feed (TA_RCA), commercial feed and food scraps (TA_RCRC); Technical assistance – no (AT_N), yes (AT_S); Education level – completed high school (ESC_EMC), completed higher education (ESC_ESC), completed elementary school (ESC_EFC), incomplete elementary school (ESC_EFI); Training – no (CAP_N), yes (CAP_S); Feed storage – no (ER_N), yes (ER_S).



Source: Authors (2024).

The extensive production system was most strongly associated with the following variables: lack of technical assistance, farmed species (tilapia), absence of feed storage, fry origin (State Department of Agricultural and Fisheries Development – SEDAP, state, and other sources), use of both commercial and alternative feed, no training, and family labor. In contrast, the semi-intensive system was associated with technical assistance, feed storage, training, hired labor, commercial feed, and fry origin from SEDAP (Figure 2A).

The extensive farming systems tend to be associated with more traditional practices (Figure 2A), whereas semi-intensive systems reflect a profile with greater access to resources. In this context, technical assistance emerges as a crucial factor for the success of fish farming. According to Curvo et al. (2020), specialized technical guidance is essential to optimize production processes and ensure the sustainability of aquaculture activities.

Training in the technical aspects of fish farming is also fundamentally important for the efficient development of the activity. However, most fish farmers lack formal training in the fish production chain, which creates difficulties in understanding the production process (Boateng et al, 2022). In addition, Kumar et al.

(2018) highlight that access to qualified labor, combined with technical extension services, is crucial for ensuring the sustainable growth of fish farming.

Acquiring fry from suppliers known for their quality, especially those involved in genetic enhancement of the species, is essential for achieving better performance metrics. However, fish farmers in Vigia de Nazaré and São Caetano de Odivelas obtain fry from various sources, including within the state, SEDAP, or third-party suppliers, which can compromise the zootechnical potential of these animals. This practice may consequently lead to reduced productivity and production losses (Jimoh et al, 2020). Because tilapia grows quickly and is readily available in the region, it has become the most utilized species among local fish farmers. This pattern reflects a broader trend in Brazil, where the tilapia production chain has significantly contributed to aquaculture development (Flores et al, 2022; Pedroza Filho et al, 2020).

In extensive fish farm systems studied, the choice between commercial and alternative feeds generally depends on each producer's financial resources and logistical capacity, allowing feeding practices to be adapted according to the availability of local inputs. Fish farming systems in Monte Alegre (Brazil) showed similar strategies in the integration of commercial and alternative feed types applied at different stages throughout the production cycle (Trombeta et al, 2020). Galvão et al. (2021) highlight commercial feed as one of the most important inputs in fish farming, as it supports fish growth and contributes to reducing wastes in effluent when administered in adequate quantities, thus mitigating environmental impacts.

Improper feed storage can promote the proliferation of microorganisms, compromising the nutritional value of the feed and increasing fish susceptibility to disease (Munoz et al, 2021). Studies conducted by Gomes et al. (2020) in the Baixada Ocidental Maranhense region revealed that many fish farmers purchase feed weekly to minimize the risk of contamination.

The MCA revealed a strong association between productivity (1.5–3 kg/m²) and several factors: fry origin, management practices, feeding strategies, access to technical assistance, commercialization methods, and the availability of adequate infrastructure (Figure 2B). Similarly, the low annual productivity (0–199 kg/year) of fish farms' Vigia de Nazaré and São Caetano de Odivelas showed a strong association with extensive management practices, the use of both commercial and alternative feed, and the sourcing of fry from external suppliers (Figure 2C). Improvement of these variables may contribute to higher annual productivity in fish farming systems; these findings indicate that they are important contributing factors.

In contrast, fry sourced from within the state demonstrated higher productivity (Figure 2B), highlighting their value as high-quality inputs capable of enhancing performance in local aquaculture.

Higher productivity also requires the provision of a balanced and high-quality diet. However, as observed in this study, many fish farmers combine commercial feed with alternative food sources, which may compromise proper fish development.

Due to the high cost of commercial feed, fish farmers tend to reduce or even withhold feed, especially in extensive systems, replacing it with alternative feed sources such as fruits and bread or, in some cases, providing no feed to the fish during the day. In the northern region of Brazil, particularly in Pará, Brabo (2014) attributes the high cost of fish feed to the lack of a consolidated Local Productive Arrangement (APL). Several studies have indicated that the use of commercial feed increases aquaculture production costs (Castro et al, 2020). Aheto et al. (2019), in their study on aquaculture in coastal Ghana, demonstrated the critical role of government and stakeholders in tackling key challenges such as fish feed costs, access to fry, and the availability of markets.

In terms of adequate infrastructure, fish farming in earthen ponds is an activity that yields financial returns (Ferreira et al, 2021). However, producers should consider optimizing technical aspects, management practices, planning, and production technology.

In Vigia de Nazaré and São Caetano de Odivelas, small landholdings restrict pond size, limiting the capacity for fry stocking. Infrastructure is typically basic and constructed by the producers themselves, a situation that often leads to stocking densities exceeding optimal levels. This factor limits large-scale production, as high stocking density may result in low productivity per square meter, especially when combined with limited infrastructure and suboptimal management (Ximenes et al, 2023). However, this issue is a reality in several regions in Brazil, and according to Valenti et al. (2021), approximately 95% of fish farms in Brazil are considered small, while only 0.1% are classified as large (over 50 hectares). Garcez et al. (2021) further reinforce this perspective by highlighting that high productivity requires effective management and administration, with proper husbandry practices to ensure greater profitability for producers.

In the extensive fish farming systems of Vigia de Nazaré and São Caetano de Odivelas, overcrowded ponds result in increased competition for space, oxygen, and feed as fish grow, ultimately leading to higher mortality rates and reduced productivity. Evidence from Mesquita et al. (2018) supports this finding, highlighting

that overcrowded stocking densities impair both feeding behavior and fish growth. Thus, acquiring knowledge is essential to support the growth of the activity and, consequently, better income generation for fish farming properties (Kato et al, 2017).

Fish farmers of the Vigia de Nazaré and São Caetano de Odivelas sell their products directly on their properties. However, challenges such as limited access and inadequate facilities pose risks to the success of the activity.

CONCLUSÃO

Fish farming in Vigia de Nazaré and São Caetano de Odivelas is characterized by small-scale producers, marked by a strong dependence on family labor and low levels of technological adoption. Productivity is closely linked to the adoption of proper management practices, technical assistance, and species selection. The predominant extensive system limits productivity, requiring the use of more efficient techniques. In addition, the activity faces challenges such as a lack of government support, limited technical assistance, financial constraints, difficulties in accessing quality inputs, and problems with product distribution, all of which hinder the sustainable development of fish farming in the region.

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Declaration of Interest

The authors report no conflicts of interest. The authors are solely responsible for the content and writing of the article.

APPROVAL OF THE ETHICS COMMITTEE INVOLVING HUMAN BEINGS

The study was approved by the Comitê Nacional de Ética em Pesquisa (CONEP), under protocol number CAAE: 83504824.9.0000.5173.

REFERENCES

AGBEKPORNU, Hayford et al. **Characteristics and structure of freshwater fish farmers in Ghana: a socio-economic analysis.** 2019.

AHETO, Denis Worlanyo; ACHEAMPONG, Esther; ODOI, Justice Odoiquaye. Are small-scale freshwater aquaculture farms in coastal areas of Ghana economically profitable? **Aquaculture International**, v. 27, n. 3, p. 785-805, 2019.

BOATENG, Charles Narteh; MTETHIWA, Austin; AGYAKWAH, Seth Koranteng. Drivers of adoption intensity of pond aquaculture: the case of Ghana. **Aquaculture**, v. 560, p. 738597, 2022. Disponível em: <https://doi.org/10.1016/j.aquaculture.2022.738597>. Acesso em: 24 mar. 2026.

BRABO, Marcos Ferreira. Piscicultura no estado do Pará: situação atual e perspectivas/Fish farming in Pará State: current status and perspectives. **Acta of Fisheries and Aquatic Resources**, v. 2, n. 1, p. i-vii, 2014.

BRABO, Marcos Ferreira et al. A piscicultura na área de influência de um grande projeto de mineração na Amazônia brasileira. **Revista Brasileira de Engenharia de Pesca**, v. 10, n. 1, p. 69-82, 2017.

CASTRO, Denys Roberto Corrêa et al. Custo de produção e rentabilidade da criação de tambaqui *Colossoma macropomum* no estado do Pará, Amazônia, Brasil. **Research, Society and Development**, v. 9, n. 9, p. e58996522-e58996522, 2020. Disponível em: <https://rsdjournal.org/index.php/rsd/article/view/6522>. Acesso em: 24 mar. 2026.

COELHO, Yana Karine da Silva et al. Perfil da piscicultura praticada no município de Alenquer, baixo Amazonas, Pará. **Brazilian Journal of Development**, v. 6, n. 1, p. 4018-4028, 2020.

Conselho Nacional de Meio Ambiente (CONAMA). **Resolução nº 413, de 26 de junho de 2009**. Diário Oficial da União: Ministério do Meio Ambiente, 26 jun. 2009. Disponível em: <https://conama.mma.gov.br>. Acesso em: 17 de maio de 2024.

Conselho Nacional do Meio Ambiente – CONAMA. **Resolução nº 357, de 17 de março de 2005**. Brasília: CONAMA, 2005. Disponível em: https://conama.mma.gov.br/?option=com_sisconama&task=arquivo.download&id=450. Acesso em: 10 de fev. 2024.

CURVO, Lucimar Rodrigues Vieira; FERREIRA, Milena Wolff; PORFÍRIO, Grasiela Edith de Oliveira; OLIVEIRA, Michel Angelo Constantino de; ALENCAR, Sônia Biaggi Alves de; COSTA, Celso Soares; ANDRADE, Gisele Braziliiano de. Avaliação da piscicultura na microrregião do Alto Pantanal – Mato Grosso, Brasil. **Scientia Plena**, [S. l.], v. 16, n. 1, 2020. DOI: 10.14808/sci.plena.2020.017401. Disponível em: <https://scientiaplenu.emnuvens.com.br/sp/article/view/5042>. Acesso em: 19 mar. 2024.

FAO – Food and Agriculture Organization of the United Nations. **The State of World Fisheries and Aquaculture: Sustainability in Action**. Rome: FAO, 2024. DOI: <https://maring.org/wp-content/uploads/2024/06/FAO-Report-The-State-of-World-Fisheries-and-Aquaculture-2024.pdf>. Acesso em: 20 de fev. 2024.

FEITOSA, Geane Pinto; SOUSA, Keid Nolan Silva. REDE ACQUAPACITA–CAPACITAÇÃO UNIVERSITÁRIA PARA O DESENVOLVIMENTO DO SEGMENTO PESQUEIRO–AQUÍCOLA DE SANTARÉM–PA. **Revista de Extensão da Integração Amazônica**, v. 1, n. 2, p. 92-95, 2019. Disponível em:

<https://periodicos.uepa.br/index.php/reia/article/view/2699>. Acesso em: 24 mar. 2026.

FERREIRA, Antônio Marcos et al. Viabilidade econômica do cultivo de tambaqui (*Colossoma macropomum*) em tanques escavados abastecidos com e sem bombeamento. *In: Viabilidade econômica e aspectos produtivos de peixes nativos da Amazônia*. Manaus: Embrapa, 2021.

FLORES, Roberto Manolio Valladão et al. Establishing linkages between consumer fish knowledge and demand for fillet attributes in Brazilian supermarkets. **Journal of International Food & Agribusiness Marketing**, v. 34, n. 4, p. 368-388, 2022.

GALVÃO, Ozias Marciliano; PINTO, Anderson Rogério Faia. Modelo para apuração de custos na produção de peixes em tanque escavado de uma propriedade rural familiar. **Custos e@ gronegocio**, v. 17, 2021. Disponível em: <http://www.custoseagronegocioonline.com.br>. Acesso em: 24 mar. 2026.

GARCEZ, Jânderson Rocha et al. Cultivo de tambaqui (*Colossoma macropomum*) em tanques-rede: Aspectos técnicos. **Research, Society and Development**, v. 10, n. 8, p. e45810817560-e45810817560, 2021. Disponível em: <https://rsdjournal.org/index.php/rsd/article/view/17560>. Acesso em: 24 mar. 2026.

GARLOCK, Taryn et al. A global blue revolution: aquaculture growth across regions, species, and countries. **Reviews in Fisheries Science & Aquaculture**, v. 28, n. 1, p. 107-116, 2020. Disponível em: <https://doi.org/10.1080/23308249.2019.1678111>. Acesso em: 24 mar. 2026.

GOMES, Irenilza de Oliveira et al. Percepção da sanidade em pisciculturas da Baixada Ocidental Maranhense, Brasil. **Braz. J. Develop.**, Curitiba, v. 6, n. 5, p. 23029-23043, 2020. Disponível em: <https://doi.org/10.34117/bjdv6n5-055>. Acesso em: 24 mar. 2026

GREENACRE, Michael J. Practical correspondence analysis. *In: Interpreting multivariate data*. [S. l.]: Academic Press, p. 119-146, 1981.

HUNGRIA, Anderson Paixão et al. Understanding the abandonment of Aquaculturists: A case in the Amazon (north of Brazil). **Aquaculture Journal**, v. 4, n. 3, p. 148-162, 2024.

IBGE – Instituto Brasileiro de Geografia e Estatística. **População no último censo 2022**. Vigia (PA): IBGE, 2022. Disponível em: <https://cidades.ibge.gov.br/brasil/pa/vigia/panorama>. Acesso em: 23 fev. 2024.

JIMOH, Abdulazeez; ADEDIGBA, Kazeem. Investigation into the abandonment of fish farms in Lagos State, southwest Nigeria. **Int J Fish Aquat Stud**, v. 8, n. 1, p. 186-191, 2020.

KATO, Hellen Christina de Almeida et al. Transferência de tecnologia em piscicultura de água doce: a experiência do projeto “Peixe Mais” no estado do Tocantins. **Extensão**, v. 16, n. 2, p. 129-146, 2017.

KUMAR, Ganesh; ENGLE, Carole; TUCKER, Craig. Factors driving aquaculture technology adoption. **Journal of the world aquaculture society**, v. 49, n. 3, p. 447-476, 2018. Disponível em: <https://doi.org/10.1111/jwas.12514>. Acesso em: 24 mar. 2026.

LI, Minghui et al. Tilapia, a good model for studying reproductive endocrinology. **General and Comparative Endocrinology**, v. 345, p. 114395, 2024. Disponível em: <https://doi.org/10.1016/j.ygcen.2023.114395>. Acesso em: 24 mar. 2026.

LIMA, Adriana Ferreira et al. Small-scale fish farming in seasonal ponds in Brazil: technical and economic characterization. **Latin american journal of aquatic research**, v. 46, n. 2, p. 314-329, 2018. Disponível em: <https://lajar.cl/index.php/lajar/article/view/vol46-issue2-fulltext-7>. Acesso em: 27 mar. 2026.

MESQUITA, Raquel Cavadas Cavadas Tavares et al. Protocol for tambaqui production based on stocking density and sex. **Revista Brasileira de Higiene e Sanidade Animal: RBHSA**, v. 12, n. 2, p. 146-155, 2018. Disponível em: <http://www.higieneanimal.ufc.br/seer/index.php/higieneanimal/article/view/438>. Acesso em: 24 mar. 2026.

MUNOZ, Liliana R. et al. Evaluation of commercially manufactured animal feeds to determine presence of Salmonella, Escherichia coli, and Clostridium perfringens. **Journal of Applied Poultry Research**, v. 30, n. 2, p. 100142, 2021. Disponível em: <https://doi.org/10.1016/j.japr.2021.100142>. Acesso em: 24 mar. 2026.

NAKAUTH, Ana Carolina Souza Sampaio et al. Caracterização da piscicultura no município de Tabatinga-AM. **Igapó Journal**, v. 9, n. 2, 2015.

OLIVEIRA, Leonnan Carlos Carvalho et al. Aspectos produtivos e econômicos da piscicultura no Arquipélago do Marajó, Pará, **Brasil. Research, Society and Development**, v. 11, n. 8, p. e45411830866-e45411830866, 2022. Disponível em: <https://rsdjournal.org/index.php/rsd/article/view/30866>. Acesso em: 24 mar. 2026.

PEDROZA FILHO, Manoel Xavier et al. **Caracterização da cadeia produtiva da tilápia nos principais polos de produção do Brasil**. Brasília: Embrapa, 2020.

PEIXE BR – Associação Brasileira da Piscicultura. **Anuário 2023 da Peixe BR da Piscicultura**. Pinheiros, São Paulo: Peixe BR, 2023. Disponível em: <https://www.peixebr.com.br/anuario/>. Acesso em: 23 fev. 2023.

PEIXE BR – Associação Brasileira da Piscicultura. **Anuário 2024 da Peixe BR da Piscicultura**. Pinheiros, São Paulo: Peixe BR, 2024. Disponível em: <https://www.peixebr.com.br/anuario-2024/>. Acesso em: 13 fev. 2024.

PENROD, Janice et al. A discussion of chain referral as a method of sampling hard-to-reach populations. **Journal of Transcultural nursing**, v. 14, n. 2, p. 100-107, 2003. Disponível em: <https://doi.org/10.1177/1043659602250614>. Acesso em: 24 mar. 2026.

SCHREIBER, Fernando Henrique da Rosa et al. Caracterização da piscicultura na região noroeste do Rio Grande do Sul. **Brazilian Journal of Development**, v. 7, n. 3, p. 27257-27275, 2021.

SILVA COELHO, Yana Karine et al. A piscicultura no Baixo Amazonas: aspectos socioeconômicos, tecnológicos e produtivos. **Research, Society and Development**, v. 9, n. 11, p. e73891110598-e73891110598, 2020.

SILVA, Fabricio Nilo Lima da et al. Challenges in the aquaculture production chain in Curralinho, Marajó archipelago, Pará, Brazil. **Braz. J. Develop**, v. 6, p. 27598-27616, 2020.

SOUSA, Raniere Garcez Costa et al. Socio-economic profile of fish farming in Presidente Médici (Rondônia-Brazil). **Biota Amazônia**, v. 9, n. 1, p. 51-55, 2019. Disponível em: <https://periodicos.unifap.br/index.php/biota/article/view/4594>. Acesso em: 24 mar. 2026.

TAKAHASHI, Leodilma Dantas Soares; DA SILVA SILVEIRA, Cleiton; JÚNIOR, Francisco das Chagas Vasconcelos. Escassez de água e seus impactos socioeconômicos na piscicultura familiar em tanques-redes no açude Castanhão no município de Jaguaribara no Ceará. **Revista Brasileira de Geografia Física**, v. 13, n. 5, p. 2476-2490, 2020. Disponível em: <https://doi.org/10.26848/rbgf.v13.5.p2476-2490>. Acesso em: 24 mar. 2026.

TROMBETA, Thiago Dias et al. Caracterização produtiva e análise do ambiente institucional da piscicultura em Monte Alegre-Pará/Productive characterization and analysis of the institutional environment of fish farming in Monte Alegre-Pará. **Brazilian Journal of Development**, v. 6, n. 2, p. 5473-5497, 2020.

VALENTI, Wagner C. et al. Aquaculture in Brazil: past, present and future. **Aquaculture Reports**, v. 19, p. 100611, 2021. Disponível em: <https://doi.org/10.1016/j.aqrep.2021.100611>. Acesso em: 24 mar. 2026.

VIANA, Diego Carvalho et al. **Cadeia produtiva da piscicultura no estado do Maranhão. Ciência e Natura**, v. 44, p. e39-e39, 2022.

VIEIRA, Vanessa Petronilo et al. Avaliação do desempenho produtivo de linhagens de tilápia do Nilo (*Oreochromis niloticus*) em Maringá-PR. **Revista Acadêmica Ciência Animal**, v. 3, n. 3, p. 19-26, 2005.

XIMENES, Luciano Feijão; VIDAL, Maria de Fatima. PISCICULTURA: v. 8 n. 272 (2023). **Caderno Setorial ETENE**, Fortaleza, v. 8, 2024. Disponível em: <https://www.bnb.gov.br/revista/cse/article/view/2675>. Acesso em: 22 mar. 2024.

XIMENES, André Felipe Moda et al. Perfil socioeconômico da piscicultura familiar em Ji-Paraná, Rondônia. **NATIVA-Revista de Ciências, Tecnologia e Inovação (ISSN: 2764-1295)**, v. 7, n. 1, p. 48-57, 2025.

ZAR, Jerrold H. **Biostatistical Analysis Prentice-Hall**. New Jersey, v. 620, p. 625, 1999.