

Case Study of a Family Fish Farming Association in Tocantins (Brazil): Challenges and Opportunities for Market Insertion*

Diego Neves de Sousa

Embrapa Pesca e Aquicultura, Palmas, Tocantins (Brasil)

Izamara Reis Davi

Alex Pizzio

Palloma Rosa Ferreira

Universidade Federal do Tocantins (Brasil)

Received: January 29, 2026 | Approved: May 21, 2026

How to cite:

de Sousa, D., Davi, I., Pizzio, A., & Ferreira, P. (2026). Case Study of a Family Fish Farming Association in Tocantins (Brazil): Challenges and Opportunities for Market Insertion. *Naturaleza y Sociedad. Desafíos Medioambientales*, 15, <https://doi.org/10.53010/nys.15.12771>

Image: Fish inside a container. Mirriana Stumpf. iStock, ID: 1493494775.

Abstract. This study analyzes market dynamics and commercialization strategies in family fish farming in the state of Tocantins, Brazil, with a focus on the Brejinho II Family Aquaculture Association, located within an aquaculture park. The research is grounded in the growing importance of family-based aquaculture as a strategy for rural development, income diversification, and food security in emerging aquaculture regions. Its main objective is to examine how collective organization influences market access and strengthens the socioeconomic position of family aquaculture. The study adopted a qualitative case study approach, combining document analysis with semi-structured interviews of members affiliated with this family aquaculture association. This methodological strategy enabled the identification of organizational, productive, and commercial transformations resulting from collective action. The findings show that implementing the aquaculture park generated significant socioeconomic benefits for the local community, including job creation, increased household incomes, and a supply of healthy food products. Furthermore, the association enabled producers to expand fish production, collectively purchase inputs, organize labor more efficiently, negotiate better market conditions, establish partnerships with public and private institutions, access public policies aimed at aquaculture, and secure technical assistance to improve production quality. The study concludes that collective organization has been a decisive factor in strengthening the insertion of family aquaculture into the formal aquaculture market. Its relevance lies in demonstrating how associative arrangements can enhance the competitiveness and sustainability of small-scale aquaculture systems. As an original contribution, the article advances the understanding of market-structuring processes in family fish farming and provides empirical evidence to support public policies and institutional strategies for the development of aquaculture in similar socio-territorial contexts.

Keywords: associativism, family aquaculture, Luís Eduardo Magalhães Hydroelectric Power Plant, productive inclusion, regional development.

Estudio de caso de una asociación de piscicultura familiar en Tocantins (Brasil): Desafíos y oportunidades para la inserción en el mercado

Resumen. Este estudio analiza la dinámica del mercado y las estrategias de comercialización de la piscicultura familiar en el estado de Tocantins, Brasil, con especial atención a la Asociación Acuícola Familiar Brejinho II, ubicada en un parque acuícola. La investigación se fundamenta en la creciente importancia de la acuicultura familiar como estrategia para el desarrollo rural, la diversificación de ingresos y la seguridad alimentaria en regiones acuícolas emergentes. Su objetivo principal es examinar cómo la organización colectiva influye en el acceso al mercado y fortalece la posición socioeconómica de la acuicultura familiar. El estudio adoptó un enfoque cualitativo de estudio de caso, al combinar el análisis documental con entrevistas semiestructuradas a miembros de la asociación acuícola familiar. Esta estrategia metodológica permitió identificar transformaciones organizativas, productivas y comerciales derivadas de la acción colectiva. Los resultados muestran que la implementación del parque acuícola generó importantes beneficios socioeconómicos para la comunidad local, mediante la creación de empleo, el aumento de los ingresos familiares y el suministro de alimentos saludables. Además, la asociación permitió a los productores ampliar la producción pesquera, adquirir insumos de forma

colectiva, organizar la mano de obra de manera más eficiente, negociar mejores condiciones de mercado, establecer alianzas con instituciones públicas y privadas, acceder a políticas públicas dirigidas a la acuicultura y obtener asistencia técnica para mejorar la calidad de la producción. El estudio concluye que la organización colectiva ha sido un factor decisivo para fortalecer la inserción de la acuicultura familiar en el mercado formal. Su relevancia radica en demostrar cómo los acuerdos asociativos pueden mejorar la competitividad y la sostenibilidad de los sistemas de acuicultura a pequeña escala. Como contribución original, el artículo profundiza en la comprensión de los procesos de estructuración del mercado en la piscicultura familiar y aporta evidencia empírica que respalda las políticas públicas y las estrategias institucionales para el desarrollo de la acuicultura en contextos socioterritoriales similares.

Palabras clave: asociativismo, acuicultura familiar, Central Hidroeléctrica Luís Eduardo Magalhães, inclusión productiva, desarrollo regional.

Estudo de caso de uma associação de aquicultura familiar no Tocantins (Brasil): desafios e oportunidades para a inserção no mercado

Resumo. Este estudo analisa a dinâmica do mercado e as estratégias de comercialização da aquicultura familiar no estado do Tocantins, Brasil, com atenção especial à Associação de Aquicultura Familiar Brejinho II, localizada em um complexo aquícola. A pesquisa baseia-se na crescente importância da aquicultura familiar como estratégia para o desenvolvimento rural, para a diversificação de renda e para a segurança alimentar e nutricional em regiões aquícolas emergentes. Seu principal objetivo é examinar como o arranjo associativo influencia o acesso a mercados e fortalece a posição socioeconômica da aquicultura familiar. Adotou-se um estudo de caso com abordagem qualitativa, combinando análise documental com entrevistas semiestruturadas com membros da associação. Essa estratégia metodológica possibilitou identificar transformações organizacionais, produtivas e comerciais derivadas da ação coletiva. Os resultados indicam que a implementação do complexo aquícola gerou benefícios socioeconômicos significativos para a comunidade local, por meio da criação de empregos, do aumento da renda familiar e da oferta de alimentos saudáveis. Além disso, a associação permitiu aos produtores ampliar a produção aquícola, adquirir insumos coletivamente, organizar o trabalho de forma mais eficiente, negociar melhores condições de mercado, estabelecer parcerias com instituições públicas e privadas, acessar políticas públicas voltadas para a aquicultura e obter assistência técnica para melhorar a qualidade da produção. O estudo conclui que os arranjos associativos têm sido fator decisivo para fortalecer a inserção da aquicultura familiar no mercado formal. Sua relevância está em demonstrar como essas formas de organização podem melhorar a competitividade e a sustentabilidade dos sistemas de produção aquícola de pequena escala. Como contribuição original, o artigo aprofunda a compreensão dos processos de estruturação de mercado na aquicultura familiar que fundamentam políticas públicas e estratégias institucionais para o desenvolvimento da aquicultura em contextos socioterritoriais semelhantes.

Palavras-chave: associação, aquicultura familiar, Usina Hidrelétrica Luís Eduardo Magalhães, inclusão produtiva, desenvolvimento regional.

Introduction

Tocantins is one of the newest states in Brazil, established on October 5, 1988. It has an estimated population of 1,511,460 people and a per capita gross domestic product (GDP) of R\$51,781.00 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2024). The state's population comprises people from various ethnic backgrounds, with a notable presence of migrants from different regions of the country, such as the Northeast and the South. As the state developed and stabilized, many individuals from other parts of Brazil migrated in search of employment and a better quality of life. This migratory flow not only made the population more diverse but also enriched cultural diversity, blending customs, traditions, and artistic expressions that reflect the inhabitants' diverse origins (Parente, 2003).

This population and cultural diversity have contributed to the development of numerous economic activities in the state, including aquaculture. Aquaculture practices in Tocantins have created new opportunities, supported by favorable hydro-climatic conditions, including ideal temperatures and abundant freshwater availability in river basins (Costa, 2023; Santana Jr., 2021).

The productive infrastructure and the ongoing expansion of aquaculture are evident in the development of a production chain in the state. Tocantins is home to two federally inspected slaughterhouses (SIF; *Serviço de Inspeção Federal*) that process and export fish; ten hatcheries that, in addition to serving the domestic market, supply other states; more than 1,000 active aquaculturists; and five licensed aquaculture parks equipped for fish farming in net cages (Secretaria da Agricultura e Pecuária [Seagro], 2023).

The state's water potential has been fully utilized, and in response to growing demand, several aquaculture parks have been auctioned for non-profit use, including the Miracema/Lajeado, Sucupira, Brejinho I, Brejinho II, and Santa Luzia Aquaculture Parks (Secretaria de Desenvolvimento da Agricultura e Pecuária, 2018). These parks not only make use of available water resources but also generate significant economic benefits, creating jobs and income for local communities, especially in regions with more pronounced inequality (Sousa *et al.*, 2025).

In particular, the municipality of Brejinho de Nazaré, home to the Brejinho II Aquaculture Park, has become a model for aquaculture growth in the state. The park's establishment has driven the sector's professionalization, promoting aquaculturist training and the adoption of good management practices. As a result, aquaculture in Tocantins has consolidated as a promising activity, contributing to the strengthening of the local economy and the expansion of the fish market (Costa, 2023; Costa & Sousa, 2025).

The analysis of the production chain and the socioeconomic dynamics of aquaculture also enables the identification of impacts, especially regarding the production of safe,

healthy foods, such as fish, which is considered an excellent source of animal protein and is known for its high quality and easy digestibility (Melo *et al.*, 2025; Pessoa *et al.*, 2020).

Furthermore, collaboration among academia, institutions, and local aquaculturists (and their collective organizations) creates a knowledge-exchange network that strengthens the sustainable development of the aquaculture sector and contributes to a solid foundation of practices and public policies that promote the growth and sustainability of aquaculture in the state. Against this backdrop, this article aims to analyze the family-based fish-farming market in Tocantins, focusing on the Brejinho II Family Aquaculture Association as a case study.

In the broader debate on small-scale aquaculture, the notion of “family-based” production goes beyond a mere legal or organizational classification of producers and encompasses a set of social relations structured around household labor, intergenerational knowledge transmission, collective decision-making, and gendered divisions of productive and reproductive responsibilities. Studies on family farming and small-scale aquaculture have emphasized that family organization is not only an economic arrangement but also a socio-technical system shaped by endogenous factors, such as labor allocation, family strategies, gender relations, and local knowledge, which interact with exogenous drivers, including public policies, market structures, and institutional support. In this sense, analyzing family fish farming in Tocantins requires attention to how these internal dynamics influence productive organization and market participation (Ferreira *et al.*, 2025; Monte *et al.*, 2025; Sousa *et al.*, 2025).

The development of family-based aquaculture in Tocantins can also be understood through its environmental implications and its alignment with the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). By promoting the production of high-quality animal protein, fish farming contributes directly to food security and improved nutrition. When conducted under technical guidance and regulated management practices, such as those implemented in licensed aquaculture parks, fish farming can support more efficient water use and reduce environmental pressures on natural fish stocks. Collective organization and technical assistance further promote the adoption of sustainable production practices, including improved feed management, waste control, and compliance with environmental regulations, thereby contributing to more responsible production systems (Grise *et al.*, 2024; Sousa *et al.*, 2022). In this context, the Brejinho II experience demonstrates that small-scale aquaculture, when embedded in associative arrangements and supported by institutional frameworks, can simultaneously generate socioeconomic benefits and advance environmental

sustainability, reinforcing its relevance as a strategy aligned with global sustainable development agendas.

Methodological approach

This study adopts a qualitative case study approach, using the Brejinho II Family Aquaculture Association as the empirical unit of analysis. The case study method was selected because it enables an in-depth investigation of contemporary social phenomena within their real-life context, particularly when the boundaries between the phenomenon and its context are not clearly defined. In this case, the approach allowed a detailed examination of the productive, organizational, and commercial dynamics that characterize family-based fish farming in Tocantins.

Data collection was conducted in January 2024 through semi-structured interviews, documentary research, and field observation. Semi-structured interviews were chosen for their flexibility in exploring participants' perceptions while maintaining analytical consistency across respondents (Lüdke & André, 1986). According to Pesce and Abreu (2019), qualitative research enables researchers to capture contextualized information directly from the environment under study, supporting interpretive analysis of complex social realities.

The association, located in the municipality of Brejinho de Nazaré, 107 kilometers from Palmas, the capital of Tocantins, had 14 active members at the time of the study. Of these, 10 members participated in the interviews, representing approximately 71% of the total membership. Data were collected using the ODK Collect platform, enabling standardized digital registration of responses in the field.

The interview script was structured around analytical categories designed to capture both endogenous and exogenous factors influencing family fish farming. These categories included: (i) gender distribution and productive roles; (ii) educational level and its relationship to commercialization strategies; (iii) access to technical assistance; (iv) access to credit and public policies; (v) commercialization channels and sales motivations; (vi) price formation mechanisms; (vii) payment arrangements; (viii) processing and value-adding practices; (ix) income diversification and the economic relevance of fish farming; and (x) organizational structure and associative dynamics. Data analysis was conducted in Microsoft Excel for coding, tabulation, and descriptive organization of qualitative and categorical information.

The study is limited to analyzing a single association, which constrains the generalizability of its findings to other aquaculture contexts. Nevertheless, the methodological depth of the case study provides insights into the organizational, productive, and

market dynamics of family-based aquaculture, offering relevant contributions to a better understanding of emerging aquaculture production territories.

Discussions on aquaculture and regional development

Although Brazil still ranks 13th globally in fish-farming production, it is the 8th-largest producer of freshwater fish (Fogaça, 2020). In 2023, national production reached 887,029 tons, a 3.1% increase from the previous year's 860,355 tons, according to Peixe BR (2023). Aquaculture in Brazil is a growing sector. In the Northern region, for instance, 143,096 tons of fish were produced in 2023, despite a slight decline from the 145,310 tons recorded in 2022 (Peixe BR, 2024). However, in Tocantins, production volume still lags behind that of other Brazilian states, ranking 18th among the largest fish producers. This indicates that the state's production potential remains underexplored (Costa, 2023).

Despite ongoing advances in the fish farming sector, the industry still faces production bottlenecks, with the primary challenge being the cost of commercial feed, which is affected by ingredient costs, industrialization, operational costs, and logistics (Pizarro Muñoz *et al.*, 2015). Variability in feed prices can directly affect production costs and, consequently, producers' competitiveness. Another challenge is the lack of infrastructure in the industrialization process, as highlighted by Branco (2022), who notes the shortage of specialized slaughterhouses. Currently, only two slaughterhouses in the state have the Federal Inspection System (SIF, for its Portuguese acronym), and there is only one feed factory.

On the other hand, some areas are already well structured. As the Peixe BR report (2023, p. 118) notes, "the state is well supported in terms of environmental licensing, has legislative support to streamline the process, and is home to the largest tilapia genetic improvement center in Brazil." Aquaculture in Tocantins is undergoing private-sector consolidation, and investment in this industry is essential to its expansion. To support this, the state created the Secretariat of Fisheries and Aquaculture of Tocantins (Sepea; *Secretaria da Pesca e Aquicultura do Tocantins*), reinforcing its commitment to developing aquaculture in the state (Peixe BR, 2024).

The production comes from private properties and from the Aquaculture Parks auctioned in Tocantins. The Brejinho II Aquaculture Park (Figure 1) occupies a defined physical space within an aquatic environment, comprising interconnected aquaculture areas where activities compatible with aquaculture are permitted (Presidência da República, 2020). The history of this park began in 2013, when, due to a decline in fish stocks in the reservoir of the Luís Eduardo Magalhães Hydroelectric Plant, professional fishermen from the region sought income-generating alternatives by transitioning to

fish farming. This process was enabled by federal public policies, culminating in the creation of the Brejinho II Aquaculture Park, located in the municipality of Brejinho de Nazaré, on the shores of the reservoir, through the public bidding notice No. 23/2013 issued by the Ministry of Agriculture, which allocated aquaculture areas as financial compensation to the local community (Costa, 2023).

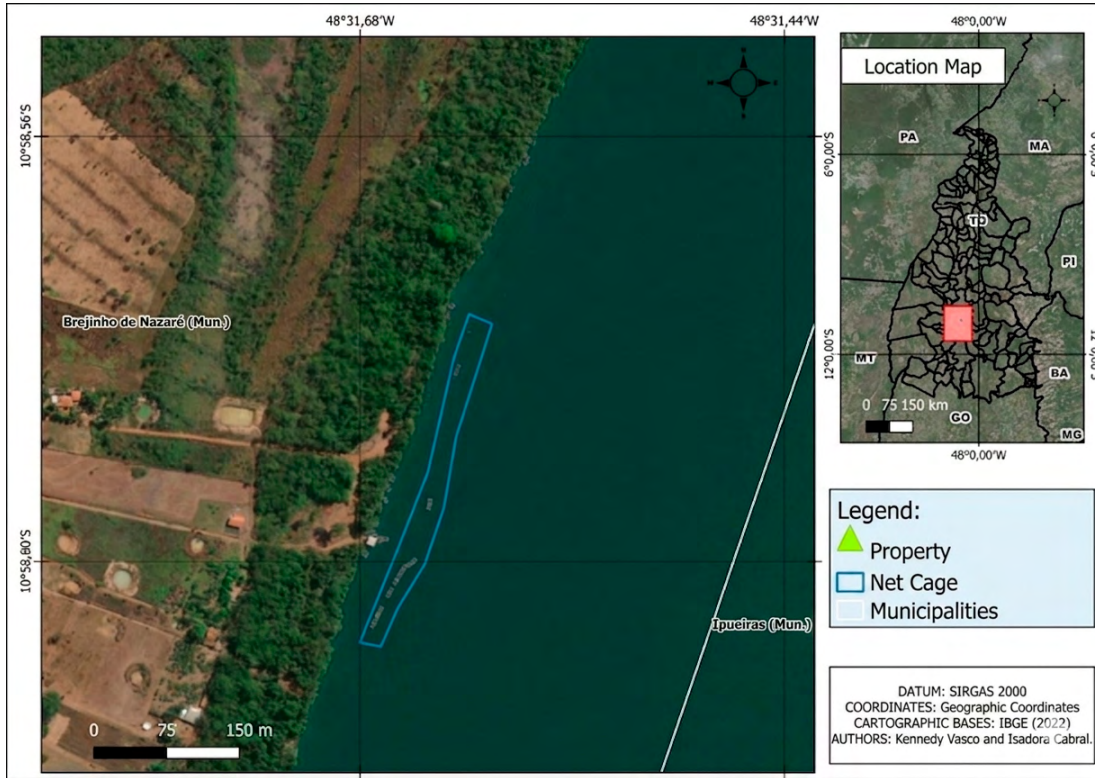


Figure 1. Map of Brejinho II Aquaculture Park. *Source:* Ministério da Agricultura e Pecuária (2022).

The physical infrastructure of the Brejinho II Aquaculture Park is robust and capable of supporting local producers, with 22 aquaculture areas, each covering 0.3 hectares, dedicated to the production of aquatic organisms. The park is also properly licensed for environmental purposes, allowing up to 48 tons per licensee annually, for a total of 1,056 tons per year (Costa, 2023).

The aquaculture chain in Tocantins is predominantly composed of small family producers, with an estimated 1,000 family aquacultures in the state, whose production is focused on subsistence and commercialization (Pedroza Filho *et al.*, 2014).

At Brejinho II Aquaculture Park, family aquaculture operations are classified as small producers. The region's socioeconomic profile indicates that 90% of producers live near the park, and 38% have per capita incomes of up to half the minimum wage (Instituto de Desenvolvimento Rural do Estado do Tocantins [Ruraltins], 2020). These families, who produce native fish species such as *tambaqui*, *pintado*, *matrinxã*, and *piau*, have

monthly incomes ranging from R\$1,501.00 to R\$4,000.00, underscoring the economic relevance of aquaculture in stimulating the local economy (Secretaria da Pesca e Aquicultura do Tocantins [Sepea], 2024).

The primary goal of aquaculture in Brejinho II is to integrate family aquacultures into the market, increase regional production, generate income for families, and promote environmental preservation (Seagro, 2017). Additionally, the region is known for producing native species, supported by 10 fish hatcheries in the state. These hatcheries provide easy access to fingerlings for local family aquacultures (Pedroza Filho *et al.*, 2014, p. 38). Native species are widely accepted by consumers and represent a significant competitive advantage for producers in Tocantins (Ruraltins, 2020).

Associativism has also emerged as a significant opportunity to strengthen the aquaculture production chain. Founded in 2018, the Brejinho II Family Aquaculture Association has become an important instrument for local family aquacultures, facilitating access to public policies, technical assistance, and strategic partnerships with institutions operating within the sector. As highlighted by Sousa *et al.* (2021; 2025), when properly structured, associations play a fundamental role in addressing collective challenges, enhancing organizational capacity, and creating new opportunities for market integration.

However, as previously mentioned, the aquaculture sector in the municipality and the state still faces bottlenecks, including a shortage of skilled labor, a lack of processing industries, difficulties with inputs, and bureaucratic issues, which limit the sector's growth, as identified in the Plan for the Development of Aquaculture in Tocantins (PDP/TO), launched in 2017. Despite this, Sepea and other organizations, such as the Brazilian Agricultural Research Corporation (Embrapa; *Empresa Brasileira de Pesquisa Agropecuária*) and the Rural Development Institute of the State of Tocantins (Ruraltins; *Instituto de Desenvolvimento Rural do Estado do Tocantins*), have been working to promote the productive inclusion of family aquacultures through actions such as simplifying environmental regularization, offering tax incentives, and promoting local fairs and sectoral events (Costa & Sousa, 2025).

Opportunities exist to overcome these challenges, including adding value to regional products, encouraging associativism and cooperativism, and proposing specific technological packages for native species and strategies to meet consumer market demand (Luiz *et al.*, 2022). With continuous investment and appropriate public policies, aquaculture in Brejinho II and in Tocantins has the potential to contribute to food security, job and income generation, and regional development.

Results and discussion

Aquaculture activity in Brejinho de Nazaré II: challenges and opportunities

In 2020, the Tocantins Aquaculture Census was conducted with the goal of mapping the aquaculture chain in the state, covering its 139 municipalities. Among the variables analyzed, the main challenges faced by the sector were highlighted, with the most frequently mentioned being: feed costs (19%), environmental licensing (16.8%), access to credit (12.1%), technical assistance (11.7%), and the selling price of fish (8%). Other challenges were also mentioned, as shown in Figure 2 (Ruraltins, 2020).

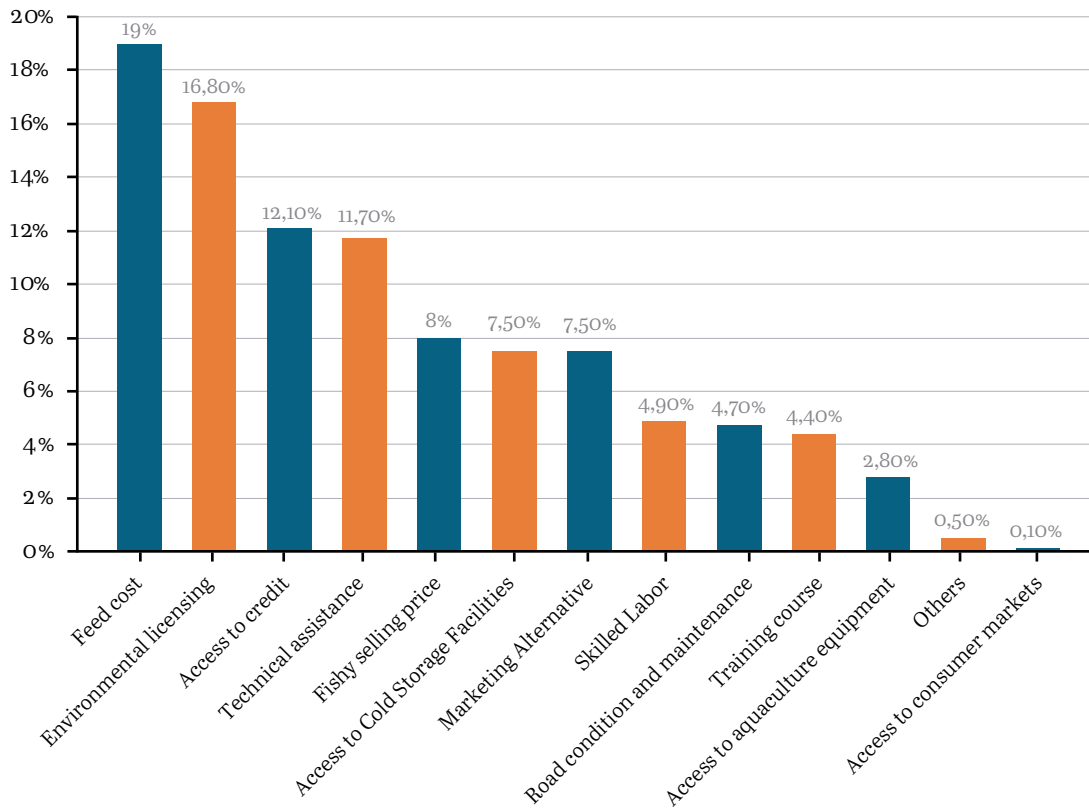


Figure 2. Challenges of aquaculture in Tocantins. *Source:* Ruraltins (2020).

In 2024, Sepea conducted a study mapping the challenges in the aquaculture sector, and the results corroborate the findings of the Tocantins Aquaculture Census conducted by Ruraltins in 2020. The study focused on the aquaculture parks of the Luís Eduardo Magalhães Hydroelectric Plant. The main challenges identified include access to agroindustry (32%), high feed costs (19%), access to credit (12%), difficulties with public access to the lake (9%), and lack of government incentives (9%), among others, as illustrated in Figure 3.

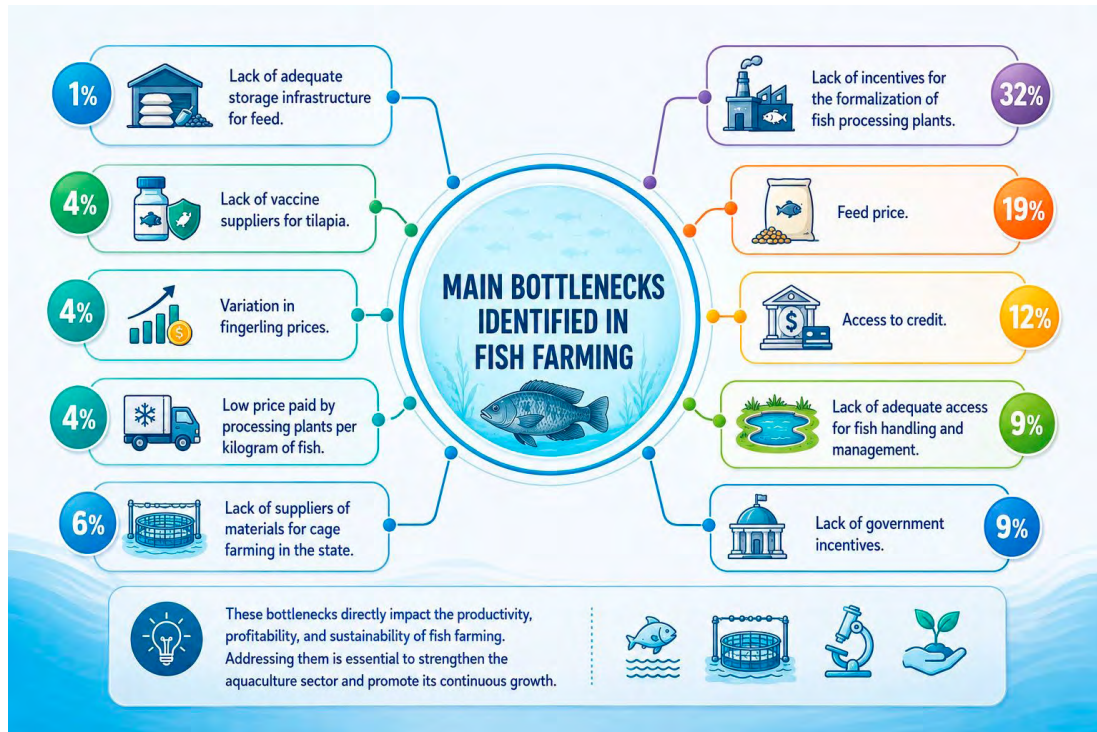


Figure 3. Challenges faced in the aquaculture parks of the Luís Eduardo Magalhães Hydroelectric Plant.
Source: Adapted from Sepea (2024).

In addition to these barriers, family aquacultures face further challenges highlighted in the studies by Ruraltins (2020) and Sepea (2024). Among these challenges, the lack of agro-industries to add value to the products, the absence of quality certifications and cuts, the difficulty in understanding consumer preferences and demands, the need to target production for specific market niches, and the scarcity of credit for financing the activity stand out (Luiz *et al.*, 2022).

Alongside the challenges identified for the performance of aquaculture activities, opportunities in the Brejinho de Nazaré scenario are also notable. Among the main opportunities are: access to high-quality fish fry, specialized technical assistance, production of healthy food, appreciation of native species, the presence of associations to secure more advantageous negotiations in both local and state trade, profit sharing, access to public policies, joint acquisition of inputs, and the generation of employment and income (Ruraltins, 2020; Sepea, 2023). These opportunities are particularly relevant, as most family aquacultures in Brejinho de Nazaré are run by low-income families and sell fish to improve household income. A study of the aquaculture park and the state's production chain shows that, despite the challenges, Brejinho II offers opportunities to boost local and regional aquaculture development.

General overview of the analyzed association

The analysis of the results revealed that 40% of the association members are women and 60% are men, all of whom are actively engaged in fish production. Although male participation remains predominant, the presence of women highlights an ongoing process of greater female inclusion in a sector historically dominated by men. These findings corroborate those reported by Ferreira *et al.* (2025), who, in a study conducted at the Brejinho II Family Aquaculture Association, observed that women have progressively expanded their participation in fish farming, representing important advances toward gender equity in the sector. However, as noted by the authors, this progress still requires targeted actions to increase women's visibility and ensure their effective inclusion in productive and decision-making processes.

In this context, the associative structure plays a strategic role by fostering cooperation, strengthening productive and managerial capacities, and facilitating market access. The results reinforce the relevance of associativism as a mechanism for overcoming individual limitations and for promoting greater integration and recognition of women's work within fish farming systems. Nevertheless, for this participation to expand sustainably, it is essential to implement initiatives that provide technical support, strengthen organizational structures, and develop public policies specifically aimed at promoting gender equity in the aquaculture sector (Ferreira *et al.*, 2025; Sousa *et al.*, 2025).

The research also included a question about the race/ethnicity of family aquaculture members. The results showed that 60% of respondents self-identified as mixed-race (*pardo*) and 30% as Black (*preto*), together comprising 90% of the sample. Only 10% identified as white. It is important to note that Black and mixed-race groups are more vulnerable to extreme poverty due to historical exclusion, such as slavery, and the insufficient implementation of public policies aimed at racial equity (Instituto de Pesquisa Econômica Aplicada [IPEA], n.d.; 2023). In this context, family-based fish farming faces significant financial challenges and vulnerabilities that hinder the productive inclusion of these individuals in the activity, thereby limiting their opportunities for development.

Producers are primarily linked to the family aquaculture association and other forms of collective organization (see Figure 4). According to Sousa and Ribeiro de Jesus (2023), cooperatives and associations help family farmers strengthen their position in formal markets by providing better negotiation terms, access to inputs, and higher profits and sales. Notably, in collective enterprises, individuals play a leading role by actively participating in decision-making and sharing the results achieved (Milagres *et al.*, 2021). This form of organization is common among family aquacultures, as exemplified by the Brejinho II Family Aquaculture Association. However, adherence to

cooperatives and associations remains a challenge for family aquacultures due to low levels of socio-productive organization (Sousa & Ribeiro de Jesus, 2023). Nonetheless, as previously mentioned, when organized collectively, family aquacultures have greater opportunities to secure benefits such as joint input acquisition, improved market conditions for their products, reduced production costs, and potential improvements in their socioeconomic conditions.

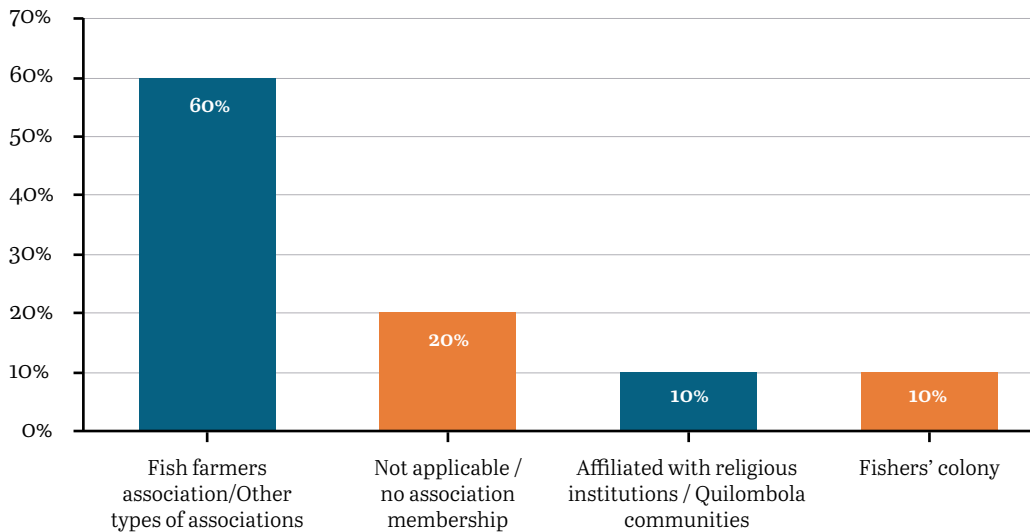


Figure 4. Social organization. *Source:* Own elaboration (2024).

Analysis of the data shows that 90% of the family aquaculturists interviewed produce fish for marketing and sale, while 10% produce for personal consumption. This indicates that fish farming plays a crucial role in income generation and the socioeconomic sustainability of the families involved. In this context, Brejinho II reflects recognition of the economic potential of Tocantins, whose economy, as highlighted by Castilho (2017), is based on the region's natural characteristics and the importance of productive inclusion through markets. Thus, fish farming at the Brejinho II Aquaculture Park not only sustains families but also strengthens family-based fish farming in the state.

Social networks play an essential role in rural digitalization, enabling users to connect, exchange information, and strengthen communication networks beyond local boundaries. In the aquaculture sector, producers are gradually adopting these digital tools and integrating them into their production routines, whether to negotiate sales, facilitate product circulation, or organize productive activities. This process improves coordination, market access, and operational efficiency in family-based aquaculture systems. Approximately 60% of producers in the Brejinho II Aquaculture Park have internet access; of these, 40% use mobile networks, and 20% have broadband. However, 40% of producers still lack internet access. This lack of access limits the enhancement of activities, particularly after the COVID-19 pandemic, which required adaptations across various sectors, including access to digital technologies. Social networks offer numerous competitive advantages for businesses when applied effectively. A digital presence

through social networks, websites, advertisements, and apps can generate significant benefits for the brand, such as constant contact with the public and increased sales (Fundação Instituto de Administração, 2024).

According to the interviewees, 50% reported using social networks to promote their products, primarily through posts on WhatsApp and Instagram. However, the other 50% do not adopt this practice to attract new customers or maintain contact with current ones. It is also observed that these family aquacultures are seeking ways to connect with consumers. Supporting this practice, Kotler & Armstrong (2018, p. 12) state, “Customer relationship management involves the entire process of building and maintaining profitable relationships with customers by delivering superior value and satisfaction.”

When asked how communication with buyers and consumers is conducted, respondents indicated that the primary method is phone, followed by in-person contact, which is still considered traditional. These two channels remain the most prevalent because they offer direct, immediate communication, which is essential for negotiations and for clarifying doubts. Phone communication allows for more personal and effective contact, enabling family aquacultures to clarify product information, negotiate prices, and build trust with consumers. In-person contact, although more limited in reach, is also valued because it offers a more personal experience, with direct interaction between producer and consumer, fostering closer relationships and customer loyalty (Sousa *et al.*, 2010). These communication methods remain dominant in the sector, highlighting the continued use of traditional practices in the local market. While these channels are effective in many ways, they have limitations, including limited scalability and reliance on both parties' availability.

The following results were obtained regarding the communication methods used by family aquacultures: phone/WhatsApp (5 mentions), in-person contact (2 mentions), technician visits to the rural establishment (1 mention), social media (1 mention), and other people (middlemen or other intermediaries) (1 mention). Direct communication via phone or WhatsApp and in-person contact were highlighted as the most effective ways to maintain relationships with buyers and consumers.

With the frequent occurrence of open-air markets, family aquacultures have the opportunity to maintain face-to-face contact with customers, which strengthens trust and provides greater security in negotiations, facilitating the marketing of their products. This type of in-person interaction fosters greater transparency and mutual understanding, which are essential for building long-lasting, trustworthy relationships.

Furthermore, direct delivery to the consumer, whether at the customer's residence or when the customer visits the farm to purchase fresh, unprocessed products, strengthens the relationship between producer and consumer. This direct marketing dynamic, enabled by short supply chains, benefits both family aquacultures and consumers. It facilitates access to fresh, high-quality food, contributes to the population's food security, ensures employment for producers, and promotes local and regional development.

Marketing channels

The results also revealed that the primary channel for product marketing is retail. Among the observed cases, 40% of sales are made to private companies, 30% to specialized stores, 10% to intermediaries, 10% to supermarkets, and 10% to general retail (Figure 5). Interviewees reported that, over the past 10 years, the frequency of these marketing channels has varied, with private companies and specialized stores predominating. These channels have proven more stable for marketing, reflecting family aquacultures' preference for establishing partnerships with such establishments to efficiently distribute their production.

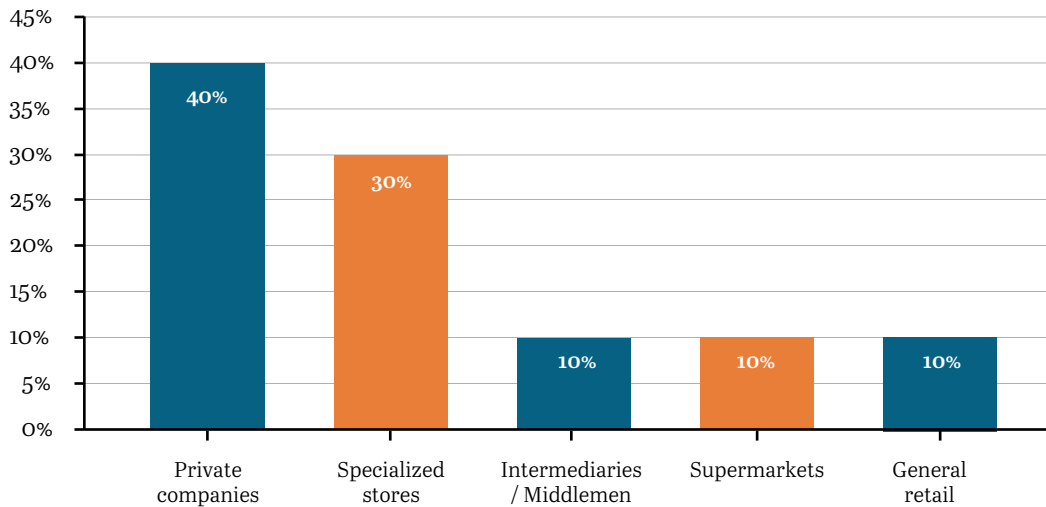


Figure 5. Frequency of marketing channels. *Source:* Own elaboration (2024).

In this context, it is evident that the Brejinho II Family Aquaculture Association's market niche is concentrated in retail. According to Kotler & Armstrong (2018, p. 17), "a market is a set of current and potential buyers of a product or service. These buyers share a particular need or desire that can be satisfied through exchange relationships." In family aquaculture, the retailer is the one who sells directly to the end consumer. Therefore, it is up to the family aquaculture to understand consumer trends, needs, and desires to satisfy them effectively.

This information is crucial for guiding the marketing process and ensuring successful transactions. Although the members of Brejinho de Nazaré maintain face-to-face contact with their consumers or communicate via social media, the negotiation and sale of their production primarily occur through channels associated with private companies and specialized stores.

To understand changes in marketing channels over the last 10 years, interviewees noted several shifts, as shown in Figure 6. Some reported a 10% to 20% increase in their channels, while others said they maintained the same sales channels. About 10%

of respondents reported a significant increase in their marketing channels, and 10% reported a considerable decrease. These data demonstrate the diversity of experiences among family aquacultures and reflect the market dynamics over time.

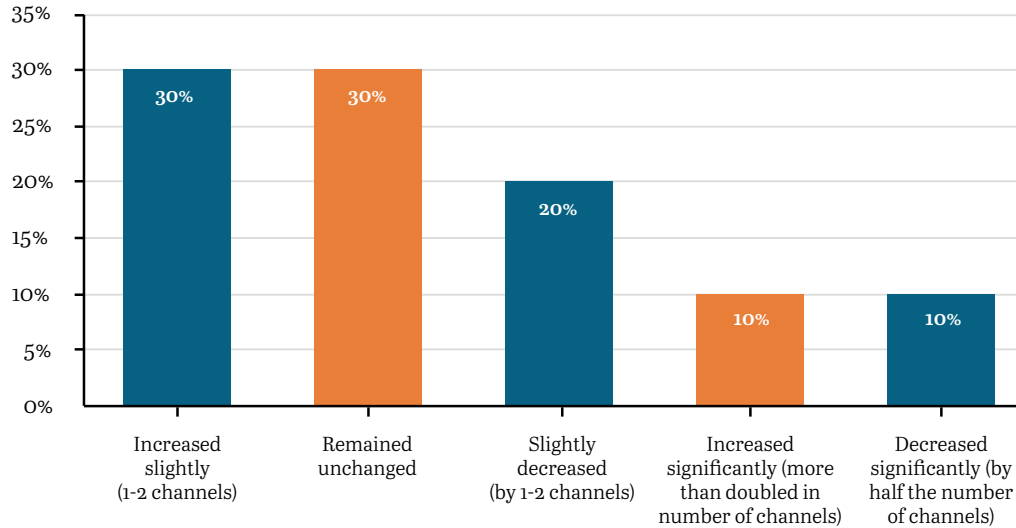


Figure 6. Frequency of marketing channels in the past 10 years. *Source:* Own elaboration (2024).

Industrialization and value addition to the product

According to information from Embrapa (2018), labeling, quality seals, designations of origin, organic certifications, and information on socially fair and environmentally friendly production systems are increasingly used to add value to products from family farming. These strategies have become essential for meeting the expectations of modern consumers and for ensuring greater competitiveness in the market. Figure 7 illustrates how products are marketed or processed in Brejinho II, highlighting the practices adopted by family aquacultures to add value to their products and improve their market presence.

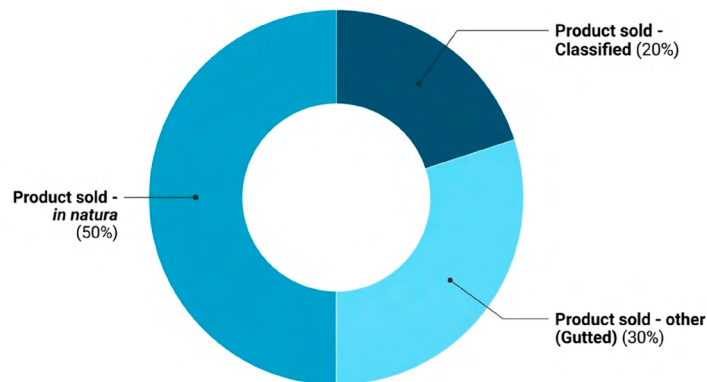


Figure 7. Forms of product marketing. *Source:* Own elaboration (2024).

It is observed that the predominant form of product commercialization is *in natura*, with processing occurring to a limited extent, encompassing activities such as sorting, washing, and packaging the fish. When an additional form of commercialization is mentioned, evisceration is cited, indicating that processing is still in its early stages in the area. *In natura* commercialization remains the main strategy. According to Castilho (2017), product industrialization emerges as an alternative for adding value, providing a more efficient exploitation of the territory's resources and market opportunities. This strategy can be crucial in boosting income generation, especially in contexts where *in natura* commercialization still prevails.

These variables, identified in the Brejinho II Aquaculture Park, reflect the challenges and opportunities faced by local family aquacultures, the profile of producers, the dynamics of commercialization, the industrialization process, and the value added to the products. It is important to note that the data from the Brejinho de Nazaré Association reflect challenges and opportunities experienced by family aquacultures in other regions of the state of Tocantins, as can be observed when comparing the more general sector data presented (Ruraltins, 2020; Sepea, 2024) with the specific data related to the case study.

Final considerations

In conclusion, the creation of the Brejinho II Aquaculture Park brought significant benefits to the local community, including income generation and the production of healthy food, such as fish. The establishment of the Brejinho II Family Aquaculture Association was crucial in increasing fish production, facilitating the acquisition of productive inputs, organizing labor management, negotiating more favorably in the formal market, seeking partnerships with the public and private sectors, accessing public policies targeted at the aquaculture sector, and obtaining technical assistance to improve production quality. All these elements contributed to the integration of these family aquacultures into the family aquaculture market.

However, there are still challenges to overcome, including high feed costs, difficulty accessing productive financing, low organizational productivity, low added value to the fish, difficulty exploring new marketing channels, limited internet access, and a lack of proper marketing planning. These obstacles have impacted the development of the Brejinho II Family Aquaculture Association.

To move forward, it is essential that members collaborate to better structure the association. They must identify internal and external factors affecting the association, seek partnerships with public and private institutions, expand their social media presence, and adopt a more competitive production culture focused on specific market niches.

Furthermore, they need to explore alternatives to add value to their products and improve their family income.

Despite the challenges, aquaculture in Brejinho II Aquaculture Park and across the state of Tocantins has the potential to contribute to food security, job creation, income generation, and regional development, provided there is sustained investment and appropriate public policies.

Statement of use of generative artificial intelligence

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) as a support tool for language revision and refinement of academic writing. All suggestions generated were critically reviewed, edited, and validated by the authors.

References

- Branco, T. C. (2022). Potencial da aquicultura no estado do Tocantins. *Blog do Helder Peixoto*. <https://www.blogdohp.com/noticia/88699/potencial-da-aquicultura-no-estado-do-tocantins>
- Castilho, M. A. (2017). *O desafio da agroindustrialização no Tocantins: Estudo de caso da cadeia produtiva da aquicultura a partir da abordagem da cadeia global de valor (GVC)* [Unpublished master's thesis]. Universidade Federal do Tocantins.
- Costa, A. C. (2023). *A inclusão produtiva de piscicultores como fator de desenvolvimento da piscicultura no estado do Tocantins: Avanços e gargalos* [Unpublished master's thesis]. Universidade Federal do Tocantins.
- Costa, A. C., & Sousa, D. N. (2025). A câmara setorial da piscicultura como ferramenta de inclusão produtiva de piscicultores. *Desenvolvimento Regional em Debate*, 15, 20–38.
- Embrapa. (2018). *Visão 2030: O futuro da agricultura brasileira*. <https://www.embrapa.br/visao/o-futuro-da-agricultura-brasileira>
- Fogaça, F. (2020, June 29). O protagonismo do Brasil na produção mundial de pescado. *Embrapa Notícias*. <https://www.embrapa.br/busca-de-noticias/-/noticia/53738345/artigo---o-protagonismo-do-brasil-na-producao-mundial-de-pescado>
- Ferreira, P. R., Sousa, D. N., Farias Santos, S. D., & Matos, F. T. (2025). Gênero na piscicultura familiar e suas implicações nas dinâmicas produtivas e organizacionais. *Revista Políticas Públicas & Cidades*, 14(1), e1644. <https://doi.org/10.23900/2359-1552v14n1-91-2025>
- Fundação Instituto de Administração. (2024, August 26). *Comércio varejista: o que é, tipos e principais tendências*. FIA Business School. <https://fia.com.br/blog/comercio-varejista/>
- Grise, M. M., Alcantara, P. H. R., Barbosa, C. F., & Sousa, D. N. (2024). Transferência de tecnologia em sistemas agrícolas no MATOPIBA e os ODS: Contribuições para a política de agricultura de baixo carbono. *Capim Dourado: Diálogos em Extensão*, 6(2), 326–359. <https://doi.org/10.20873/v6/TT>

- Instituto Brasileiro de Geografia e Estatística (IBGE). (2024). *Tocantins*. IBGE. <https://cidades.ibge.gov.br/brasil/to/panorama>
- Instituto de Desenvolvimento Rural do Estado do Tocantins (Ruraltins). (2020). *Censo da piscicultura no Tocantins*. <https://central.to.gov.br/download/82724>
- Instituto de Pesquisa Econômica Aplicada [IPEA]. (n.d.). *Retrato das desigualdades de gênero e raça*. <https://www.ipea.gov.br/portal/retrato/indicadores/renda-pobreza-e-desigualdade/apresentacao>
- Instituto de Pesquisa Econômica Aplicada [IPEA]. (2023). *Igualdade racial: Políticas sociais, acompanhamento e análise*. IPEA. <https://repositorio.ipea.gov.br/server/api/core/bitstreams/b6e08a9f-d5d9-4ffc-a097-77e4cbcb49c9/content>
- Kotler, P., & Armstrong, G. (2018). *Princípios de marketing* (15th ed.). Pearson.
- Lüdke, M., & André, M. E. D. A. (1986). Métodos de coleta de dados: Observação, entrevista e análise documental. In *Pesquisa em educação: Abordagens qualitativas* (pp. 1–22). EPU.
- Luiz, D. de B., Oliveira, I. S., Cavali, J., Lundstedt, L. M., Flores, R. M. V., & Dantas Filho, J. V. (2022). Caminhos para organização da cadeia da aquicultura da Amazônia: Perspectivas econômicas e relevância social e ambiental. In *As soluções sustentáveis que vêm dos trópicos: desenvolver sem desmatar por um novo pacto global do alimento* (pp. 299–311). Juiz de Fora: Ed. Garcia. <http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/1150197>
- Melo, M. C. C., Munoz, A. E. P., Carneiro Carvalho, E. F., Sousa, D. N., Alves, A. L., Oliveira, D. M., Onoyama Moria, S. S., & Pieroni Iwashita, M. K. (2025). TambaPlus Parentesco: Avaliação dos impactos econômicos e custos da solução tecnológica. *Cadernos de Ciência & Tecnologia*, 42, e27805.
- Milagres, C. S. F., Petarly, R. R., Melo, J. A., & Sousa, D. N. (2021). *Gestão coletiva na piscicultura familiar: Organização do quadro social e práticas sustentáveis*. Embrapa. <https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1131770/1/cartilha2.pdf>
- Ministério da Agricultura e Pecuária. (2022). *Sistema de Informação das Autorizações de Uso das Águas de Domínio da União para fins de Aquicultura*. <https://www.gov.br/agricultura/pt-br/aceso-a-informacao/tecnologia-da-informacao/sistemas/orgaos/mpa/administrativo/sinau-sisteman-nacional-de-aguas-da-uniao>
- Monte, C. G. I., Sousa, D. N., & Ferreira, P. R. (2025). Questões de gênero na extensão rural brasileira: Revisão bibliométrica sob a perspectiva dos Objetivos de Desenvolvimento Sustentável. *Mundo Agrario*, 26, e270.
- Pizarro Muñoz, A. E., Valladão Flores, R., Oeda Rodrigues, A. P., & Mataveli, M. (2015). Aquicultura: Atividade em ascensão. *Boletim Ativos da Aquicultura*, 1(1), 1–4. <https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1041208/1/CNPASA2015aa1.pdf>
- Parente, T. G. (2003). *Fundamentos históricos do estado do Tocantins colonial*. UFG.
- Pedroza Filho, M. X., Barroso, R. M., & Valladão Flores, R. M. (2014). *Diagnóstico da cadeia produtiva da piscicultura no estado de Tocantins*. Palmas: Embrapa Pesca e Aquicultura.
- Peixe BR. (2023). *Anuário 2023 Peixe BR da piscicultura: A força do peixe brasileiro*. <https://static.poder360.com.br/2023/08/AnuarioPeixeBR2023.pdf>

- Peixe BR. (2024). *Anuário 2024 Peixe BR da piscicultura: Brasil produz 887.029 t de peixes de cultivo*. <https://www.peixebr.com.br/anuario-2024>
- Pesce, L., & Abreu, C. B. M. (2019). Pesquisa qualitativa: Considerações sobre bases filosóficas e princípios norteadores. *Revista da FAEEBA – Educação e Contemporaneidade*, 22(40), 19–29. <https://doi.org/10.21879/faeeba2358-0194.2013.v22.n40.p19-29>
- Pessoa, R. M. S., Castro Costa, D. C., Ferreira da Silva, A. A., & Araújo, C. A. (2020). Avaliação das preferências dos consumidores de pescado no município de Piancó-PB. *Diversitas Journal*, 5(4), 2408–2421. <https://doi.org/10.17648/diversitas-journal-v5i4-1102>
- Presidência da República. (2020). Decreto nº 10.576, de 14 de dezembro de 2020. https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2020/decreto/d10576.htm
- Santana Jr., J. (2021, May 15). Tocantins possui potencial hídrico e temperatura da água considerados ideais para a piscicultura. *Governo do Tocantins*. <https://www.to.gov.br/noticias/tocantins-possui-potencial-hidrico-e-temperatura-da-agua-considerados-ideais-para-a-piscicultura/2vicmbtrcru4>
- Secretaria da Agricultura e Pecuária (Seagro). (2017). Parque aquícola pode gerar cerca de R\$ 5 milhões por ano para piscicultores de Brejinho de Nazaré. *AgroLink*. https://www.agrolink.com.br/noticias/parque-aquicola-pode-gerar-cerca-de-r-5-milhoes-por-ano-para-piscicultores-de-brejinho-de-nazare_369100.html
- Secretaria da Agricultura e Pecuária (Seagro). (2023). Aquicultura e pesca. *Governo do Tocantins*. <https://www.to.gov.br/seagro/aquicultura-e-pesca/5sperzub2ei7>
- Secretaria da Pesca e Aquicultura do Tocantins (Sepea). (2023). *Cadeia da piscicultura no Tocantins: Cenário atual dos elos da piscicultura no Estado do Tocantins*. <https://central.to.gov.br/download/368956>
- Secretaria da Pesca e Aquicultura do Tocantins (Sepea). (2024). *Diagnóstico técnico: Parques aquícolas UHE Luiz Eduardo Magalhães*. <https://central.to.gov.br/download/380744>
- Secretaria de Desenvolvimento da Agricultura e Pecuária. (2018). *Situação atual da aquicultura tocantinense*. <https://central.to.gov.br/download/114990>
- Sousa, D. N., & Ribeiro de Jesus, M. E. (2023). A contribuição do cooperativismo para inclusão produtiva de agricultores familiares. *Revista Cooperativismo & Desarrollo*, 31(125), 1–21.
- Sousa, D. N., Pinho, J. B., Amodeo, N. B. P., & Milagres, C. S. F. (2010). O papel da comunicação na transmissão da educação cooperativista. *Revista de Ciências Humanas*, 9, 204–215.
- Sousa, D. N., Petarly, R. R., Milagres, C. S. F., Melo, J. A., & Kato, H. C. A. (2021). *Acesso às políticas públicas pelos piscicultores familiares*. Embrapa. <https://www.embrapa.br/busca-de-publicacoes/-/publicacao/1131769/acesso-as-politicas-publicas-pelos-piscicultores-familiares>
- Sousa, D. N., Ribeiro, M. E., & Grise, M. (2022). Contributions of Family Farming to the Achievement of the Sustainable Development Goals (SDG). *Revista Brasileira de Educação do Campo*, 7, 1–20. <https://doi.org/10.20873/uft.rbec.e13837>
- Sousa, D. N., Santos, S. D. F., Ferreira, P. R., & Matos, F. T. (2025). Acesso à orientação técnica e sua influência no desenvolvimento das práticas produtivas de piscicultores familiares organizados em associação. *Cuadernos de Educación y Desarrollo*, 17(2), 1–19. <https://doi.org/10.55905/cuadv17n2-080>

:: :: ::

About this article

This article is based on research conducted by the Brazilian Agricultural Research Corporation (Embrapa) from 2023 to 2025 in the municipality of Brejinho de Nazaré, Tocantins, Brazil. The study was funded by the Tocantins Research Support Foundation (FAPT).

↑

About the authors

Diego Neves de Sousa. Postdoctoral researcher in the Program on Intellectual Property and Technology Transfer for Innovation at the Federal Universidade Federal do Tocantins (UFT). Supervisor of the Technology Prospecting and Evaluation Division (SPAT) at Embrapa Fisheries and Aquaculture; Professor in the Graduate Program in Regional Development in the Society and Public Policy Research Track; CNPq Fellow in Technical Design and Innovative Extension. Contribution: conception and drafting of the paper. Recent publications: Sousa, D. N. de, & Costa, A. C. (2025). Productive inclusion in the perspectives of the members of the fishery sector chamber of Tocantins. *Interações*, 26, e26034356; Sousa, D. N. de, Chama da Costa, A., Rosa Ferreira, P., & Dias Farias Santos, S. (2025). Estratégias utilizadas pelas organizações da cadeia da piscicultura no Tocantins (Brasil) para promover a inclusão produtiva. *Estudios Rurales*, 15, 1–18. diegocoop@hotmail.com. ORCID: <https://orcid.org/0000-0003-3124-5150>

↑

Izamara Reis Davi. BA in Administration, Universidade Federal do Tocantins (UFT). Contribution: data collection and analysis and manuscript writing. Latest publications: Davi, I. R., Sousa, D. N. de, Ferreira, P. R., Matos, F. T., Kato, H. C. A., & Carvalho, E. de F. C. (2025). Caminhos e estratégias para a inserção da piscicultura familiar em mercados a partir de um estudo de caso. In *A engenharia de pesca frente aos desafios da economia azul e da resiliência climática (Trabalho apresentado no XXIII Congresso Brasileiro de Engenharia de Pesca – CONBEP)*. Belém, PA, Brasil. Email: reis.davi@mail.uft.edu.br. ORCID: <https://orcid.org/0000-0003-0227-5780>

↑

Alex Pizzio. Professor, Universidade Federal do Tocantins (UFT). Postdoctoral fellow at Universidad Nacional Autónoma de México (UNAM) and the University of Illinois at Urbana-Champaign (UIUC). Associate Professor IV at UFT and a CNPq research productivity fellow. President of the Network of Postgraduate Programs in Urban and

Regional Planning of Central-Northern Brazil, vice-president of the Brazilian Society for Regional Development (SBDR Região Norte), member of the Mexican Association of Sciences for Regional Development (AMECIDER), and a member of the Regional Science Association International (RSAI). Contribution: conception and writing of the work, critical review, and final approval. Latest publications: Jesus, V. G. S., Pizzio, A., & Jesus, A. (2025). Systematic literature review on methodologies applied to tourism and cultural offerings inventorying among traditional peoples. *Revista Brasileira de Gestão e Desenvolvimento Regional*, 21, 4–30; Mauricio, N. M. M., Pizzio, A., Oliveira, N. M., & Almeida, L. A. (2024). Rede de cooperação entre pesquisadores do XIX ENANPUR. *DRd – Desenvolvimento Regional em Debate*, 14, 121–132. Email: alexpizzio@gmail.com. ORCID: <https://orcid.org/0000-0001-7181-6355>

↑

Palloma Rosa Ferreira. Postdoctoral researcher in the Postgraduate Program in Regional Development (PPGDR) at Universidade Federal do Tocantins (UFT). Research area: society and public policies. Contribution: manuscript writing. Latest publications: Ferreira, P. R., Sousa, D. N. de, Santos, S. D. F., & Matos, F. T. de. (2025). Gênero na piscicultura familiar e suas implicações nas dinâmicas produtivas e organizacionais. *Revista Políticas Públicas & Cidades*, 14, e1644-14. <https://doi.org/10.23900/2359-1552v14n1-91-2025>; Sousa, D. N. de, Santos, S. D. F., Ferreira, P. R., & Matos, F. T. de. (2025). Acesso à orientação técnica e sua influência no desenvolvimento das práticas produtivas de piscicultores familiares organizados em associação. *Cuadernos de Educación y Desarrollo*, 17, <https://doi.org/10.55905/cuadv17n2-080>. Email: palloma.rosa.ferreira@gmail.com. ORCID: <https://orcid.org/0000-0001-7523-4731>

↑