Demands and Challenges of Public Policies for Family Fish Farming: A Case Study in Brazil*

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Abstract. This study analyzes the demands and challenges of public policies for family fish farming in the state of Tocantins, Brazil, with an emphasis on fish marketing, production organization, and access to public policies. The research is based on an empirical survey of three family fish farmers' associations. Twenty-six interviews were conducted using a structured questionnaire covering socio-productive and organizational aspects, market typologies, and access to public policies. The results indicate that infrastructure fragility, especially the lack of properly certified fish-processing units, is a major bottleneck to accessing institutional markets. Furthermore, the lack of coordination between public policies and regulatory frameworks, as well as the inadequacy of sanitary requirements relative to the realities of family fish farming, are identified as factors that induce productive informality. Public technical assistance proved central to accessing credit, regularizing documentation, and entering formal markets. It is concluded that strengthening family fish farming in this context requires integrated public policies that support collective organizations, implement public processing infrastructure, expand continuous technical assistance, and adapt regulatory frameworks to territorial specificities, thereby contributing to more sustainable, equitable, and resilient aquaculture systems.

Keywords: family fish farming, fish commercialization, governance, public policies, socio-productive inclusion.

Demandas e Desafios das Políticas Públicas para a Piscicultura Familiar: Um Estudo de Caso no Brasil

Resumo. Este estudo analisa as demandas e os desafios das políticas públicas para a piscicultura familiar no estado do Tocantins, Brasil, com ênfase na comercialização de peixes, na organização da produção e no acesso às políticas públicas. A pesquisa baseia-se em um levantamento empírico de três associações de piscicultores familiares. Foram realizadas vinte e seis entrevistas por meio de um questionário estruturado que abrangeu aspectos socioprodutivos e organizacionais, tipologias de mercado e acesso às políticas públicas. Os resultados indicam que a fragilidade da infraestrutura, especialmente a ausência de unidades de processamento de pescado devidamente certificadas, constitui um importante gargalo para o acesso a mercados institucionais. Além disso, a falta de articulação entre as políticas públicas e os marcos regulatórios, bem como a inadequação das exigências sanitárias às realidades da piscicultura familiar, são identificadas como fatores que induzem à informalidade produtiva. A assistência técnica pública mostrou-se central para o acesso ao crédito, a regularização da documentação e a inserção em mercados formais. Conclui-se que o fortalecimento da piscicultura familiar nesse contexto requer políticas públicas integradas que apoiem organizações coletivas, implementem infraestrutura pública de processamento, ampliem a assistência técnica contínua e adaptem os marcos regulatórios às especificidades territoriais, contribuindo, assim, para sistemas de aquicultura mais sustentáveis, equitativos e resilientes.

Palavras-chave: piscicultura familiar, políticas públicas, comercialização de pescado, governança, inclusão socioprodutiva.

Las demandas y los desafíos de las políticas públicas para la piscicultura familiar: estudio de caso en Brasil

Resumen. Este estudio analiza las demandas y los desafíos de las políticas públicas para la piscicultura familiar en el estado de Tocantins, Brasil, con énfasis en la comercialización del pescado, la organización de la producción y el acceso a dichas políticas. La investigación se basa en una encuesta empírica aplicada a tres asociaciones de piscicultores familiares. Se llevaron a cabo veintiséis entrevistas mediante un cuestionario estructurado que abarcaba aspectos socioproductivos y organizativos, tipologías de mercado y el acceso a las políticas públicas. Los resultados indican que la fragilidad de la infraestructura, especialmente la falta de plantas procesadoras de pescado debidamente certificadas, constituye un obstáculo importante para el acceso a los mercados institucionales. Además, la falta de coordinación entre las políticas públicas y los marcos regulatorios, así como la insuficiencia de los requisitos sanitarios con respecto a la realidad de la acuicultura familiar, se identifican como factores que fomentan la informalidad productiva. La asistencia técnica pública resultó fundamental para acceder al crédito, regularizar la documentación e ingresar a los mercados formales. Se concluye que el fortalecimiento de la piscicultura familiar en este contexto requiere políticas públicas integradas que apoyen a las organizaciones colectivas, implementen infraestructura pública de procesamiento, amplíen la asistencia técnica continua y adapten los marcos regulatorios a las especificidades territoriales, contribuyendo así a sistemas acuícolas más sostenibles, equitativos y resilientes.

Palabras clave: piscicultura familiar, políticas públicas, comercialización del pescado, gobernanza, inclusión socioproductiva.

Introduction

The fish production chain has strategic relevance in both economic and social spheres by promoting job and income generation, especially among socially vulnerable families. Furthermore, it helps strengthen food and nutritional security by providing a source of high-biological-value animal protein for both producers and consumers (Sousa & Kato, 2017). Despite this importance, family fish farmers face significant restrictions in accessing various marketing channels, which compromises the economic sustainability of the activity and limits its potential to contribute to fairer and more resilient food systems.

The Northern region of Brazil stands out in national fish production due to its favorable environmental and soil-climatic conditions, abundant water resources, and the diversity of native species, factors that expand opportunities for productive and market diversification. The presence of extensive hydrographic basins and reservoirs associated with hydroelectric power plants positions the region strategically for investments in fish farming, an activity with significant growth prospects (Relvas *et al.,* 2023).

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In the state of Tocantins, located in Brazil's Northern region, fish farming has expanded amid institutional opportunities and incentives from both governmental and non-governmental entities. The establishment of Empresa Brasileira de Pesquisa Agropecuária (Embrapa; Brazilian Agricultural Research Corporation) in 2009, with a focus on fisheries and aquaculture chains, marked a significant milestone, boosting research, development, and innovation efforts in the sector. Subsequently, the formulation of the Fish Farming Development Plan for Tocantins (PDP/TO; *Plano de Desenvolvimento da Piscicultura do Tocantins*) in 2017 set ambitious goals for production expansion, aiming to position the state as one of the main national producers of fish. As a result, the Tocantins Fish Farming Sectoral Chamber (CSP/TO) was established in 2019, bringing together representatives from public and private institutions, as well as social organizations active in this productive chain (Costa, 2023).

This set of actions offers concrete opportunities for the productive inclusion of family fish farmers in markets because, as Sousa *et al.* (2025a) highlight, productive inclusion actions are tailored to the specificities of each organization. These initiatives can range from simpler measures, such as encouraging the collective organization of fish farmers for joint purchases of inputs, to the implementation of more structured public policies backed by specific legislation, as described above in the state of Tocantins. Such policies seek to strengthen aquaculture by reducing bureaucracy and minimizing bottlenecks in the value chain, thereby enabling fish farmers to access segments that were previously restricted or difficult to enter.

In this interim, promoting the productive inclusion of individuals and families in vulnerable situations requires reforming policies and programs, as well as the practices of civil society organizations, to scale up the results already achieved while addressing contemporary challenges. This innovative approach demands a systemic, multidimensional perspective on productive inclusion, grounded in greater coordination among the social, environmental, and productive dimensions; strengthening the conditions and capacities of vulnerable individuals and families; expanding opportunities and qualifying the economic environment in which they are embedded; integrating efforts among the state, civil society organizations, and the private sector; and ensuring the suitability and flexibility of initiatives regarding the ways of life and methods of valuing the biological and cultural diversity present in Brazilian rural regions (Favareto *et al.*, 2022).

Thus, intervention actions aimed at productive inclusion have sought to promote the entry of populations living in extreme poverty into the workforce. However, in rural contexts, it is essential to recognize that a large portion of this population is already engaged, to some extent, in productive activities. Nonetheless, they do so under precarious conditions, with production destined primarily for their own subsistence. Therefore, rather than merely enabling entry into the workforce, the focus of

interventions shifts toward strengthening production conditions and expanding opportunities for qualified insertion into markets (Vahdat *et al.*, 2020).

In this context, markets can be understood as concrete social spaces where exchanges between actual producers and consumers occur, guided by institutional structures and moral values that confer legitimacy on these interactions. From this perspective, the creation of new marketing spaces becomes a central element of inclusion strategies because of their potential for income generation and value addition, as well as their role in recognizing the symbolic aspects that identify, differentiate, and qualify food from diverse forms of family farming (Niederle, 2017).

Institutional markets have played an important role in strengthening family farming and its collective organizations. These markets are structured around public demand and primarily involve governmental and non-governmental institutions that promote initiatives such as fair trade. Because they are highly regulated, they operate under specific legislation, bidding regulations, and public procurement policies. These markets are attractive to family farmers because they offer better prices and greater payment security. Key examples include school feeding programs and food procurement initiatives that supply food baskets to public facilities serving non-profit organizations (Schneider, 2016).

Thus, marketing agri-food products is one of the most critical stages of the production process, as it represents the final link in the productive inclusion of family farmers in markets. It is also a highly complex phase and is frequently identified as a major bottleneck for collective organizations and individual producers (Sousa & Ribeiro de Jesus, 2023). In family fish farming, these challenges are compounded by fish perishability, sanitary requirements, and limited productive and logistical organizational capacity.

In light of the actions implemented in the state to improve fish farming, the question arises: in what ways have family fish farmers in the state of Tocantins accessed markets and marketing channels? Therefore, the objective of this study is to present the challenges and opportunities faced by family fish farmers in accessing markets, in line with the principles of sustainable aquaculture, social equity, and inclusive rural development.

Methodology

The production of freshwater fish in Tocantins, especially through net-pen systems installed in the public waters of hydroelectric power plants, has become a significant activity in family fish farming and an important alternative for expanding production. These pens, consisting of mesh structures and supplied with feed, enable the confinement of fish in a controlled environment, favoring productivity and animal growth.

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Furthermore, this model leverages the water infrastructure and the strategic location of the power plants, as seen at Palmas Lake, thereby strengthening aquaculture activity and income generation. However, dependence on factors such as water-level variations and climate conditions demands continuous monitoring, posing significant challenges for small-scale producers (Schulter & Vieira Filho, 2017).

These distinctive fish-farming characteristics in the state prompted the selection of three family fish farmers' associations in three municipalities along the shores of Palmas Lake, formed by the construction of the Luís Eduardo Magalhães Hydroelectric Power Plant on the Tocantins River. The reservoir is known for its rich aquatic fauna and spans more than 170 km. It represents 0.23% of the total area of the state of Tocantins; it was constructed in 2001 for power generation, with an approximate output of 902.5 MW per day. The aquaculture parks in Palmas Lake, established by the Ministry of Fishing and Aquaculture (MPA; *Ministério da Pesca e Aquicultura*) in 2013, include the Sucupira Aquaculture Park in Palmas, the Miracema/Lajeado Aquaculture Park in Lajeado, and the Brejinho II Aquaculture Park in Brejinho de Nazaré. These parks represent a strategic infrastructure for family fish farming production in net pens, providing a foundation for the activity in Tocantins.

A structured questionnaire administered via the ODK Collect software[1] served as the research instrument, enabling cross-referencing of data and the organization, tabulation, and mapping of the results. The instrument included information on family nucleus characteristics, socio-productive aspects, specificities of the main product, and typologies of the markets accessed. Fish farmers associated with the collective organizations of BomPeixe (Palmas), Brejinho de Nazaré (Brejinho de Nazaré), and Peixe do Segredo (Lajeado) participated in the study, for a total of 26 interviews conducted between November 2023 and February 2024.

Infrastructure and strengthening of fish farmers' associations and cooperatives

The formation of associations and cooperatives is a central strategy for strengthening the productive organization of family fish farming, enabling cost reductions through collective purchases of inputs, compliance with market requirements, and greater bargaining power. Furthermore, collective action fosters the exchange of experiences, access to new marketing channels, and cooperation among producers, thereby expanding opportunities to generate more stable and predictable income (Oliveira & Pedroza Filho, 2020; Sabbag, 2008;Sousa & Ribeiro de Jesus, 2023).

1 The ODK Collect software was developed as part of the "Public Policies and Innovations for Building More and Better Markets for Family Farmers in Brazil" project.

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Associativism is an organized strategy based on a network of individuals who, influenced by the social context in which they are embedded and articulated through relationships, strengthen cooperation based on common interests. This process helps promote greater transparency and efficiency in collective management (Fagotti, 2017).

The results of the empirical research corroborate this perspective, showing that associative organization helps expand market access by reducing costs, improving production planning, enhancing technical quality, and increasing marketing efficiency. Furthermore, associations facilitate collective bargaining and promote the circulation of knowledge among producers. However, institutional incentives to create these organizations in the state of Tocantins remain limited, as reflected in the low level of adherence among family fish farmers to formal organizational arrangements. Given this scenario, the adoption of more consistent initiatives by public authorities becomes fundamental.

According to Sampaio *et al.* (2018), in local productive clusters, social capital built through community relationships enables members to assume greater leadership roles. The higher this social capital, the greater the likelihood of collective initiatives focused on the common interest. These collective arrangements serve as strategic instruments for organizing production, enabling economies of scale, cost reduction, greater bargaining power, and a more competitive insertion into formal and institutional markets. In this regard, the establishment of associations and cooperatives constitutes a relevant strategy for productive inclusion, as it allows producers to organize themselves to meet market demands more efficiently (Sousa & Ribeiro de Jesus, 2023).

The research also revealed significant weaknesses in the infrastructure of the associations studied. Despite their strategic potential, these organizations lack adequate facilities for storing, preserving, and processing fish, a critical gap given fish's high perishability. Across all the associations studied, the available infrastructure proved insufficient to meet the requirements of formal markets, compromising proper handling, product quality, and compliance with sanitary regulations.

In this context, strengthening associations and cooperatives requires public policies that prioritize investment in productive infrastructure, including equipment acquisition, facility upgrades, and continuous technical support. As Sousa (2021) emphasizes, marketing fish across different markets remains a significant challenge due to the discontinuity of public policies directed at the aquaculture sector and the product's high perishability. This characteristic requires sound storage practices and agile marketing logistics to ensure the product reaches the final consumer properly. Such measures are essential for compliance with sanitary requirements, improving working conditions, and expanding opportunities to enter more demanding and diversified markets, in line with the principles of sustainable aquaculture.

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Disarticulation of public policies and fish legislation

Despite the recognized socioeconomic and nutritional importance of the fish supply chain, a significant disconnect is evident between public policies and the legal frameworks governing the sector. A primary cause of this disarticulation is the state's institutional fragmentation, marked by the sectorized performance of different agencies and spheres of government, without effective mechanisms for coordination and integration. This lack of inter-institutional articulation compromises policy coherence, reducing its capacity to promote the integrated development of the production chain and limiting its effectiveness.

This dynamic was evident in the empirical results, as a significant portion of the associated family fish farmers reported not accessing strategic public policies, such as the Food Acquisition Program (PAA; *Programa de Aquisição de Alimentos*) and the National School Feeding Program (PNAE; *Programa Nacional de Alimentação Escolar*). Notably, 31% of interviewees lacked the National Registry of Family Farming (CAF; *Cadastro Nacional da Agricultura Familiar*), a fundamental requirement for accessing various public policies (agricultural, agrarian, social, market, and food security). Furthermore, access to credit proved to be restricted, with only 27% of fish farmers reporting obtaining some form of financing.

Another critical element concerns the sanitary requirements and normative frameworks for fish processing, which are largely structured around industrial parameters that assume large-scale production, capitalization, and process standardization. At times, these frameworks are based on patterns and paradigms of large-scale agro-industrial production. In this sense, such a model tends to reinforce an exclusionary and concentrating logic across production, processing, and distribution. Furthermore, the multiplicity of agencies responsible for regulation and inspection hinders understanding of the rules and fails to account for local specificities and distinct production scales in risk analysis (Presidência da República Secretaria-Geral, 2024).

Such requirements disregard the diversity of production forms characteristic of family fish farming, pushing many producers into informality as an economic survival strategy. Thus, there is a mismatch between current legislation and territorial realities, especially in regions marked by long distances, logistical weaknesses, the absence of collective processing units, and infrastructure limitations, as in Tocantins. Consequently, the lack of sanitary certification among the investigated family fish farmers limits access to more demanding and competitive markets and compromises consumer trust in product quality. Furthermore, deficiencies in productive and commercial infrastructure intensify these difficulties. For this reason, the marketing of processed products does not occur, as none of the associations possesses a

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collective processing facility or sanitary certification, both of which are fundamental requirements for value addition and entry into the formal market (Santos, 2025).

These limitations in fish marketing highlight the need for improvements across various stages of the production chain, especially in production and processing operations. To strengthen the fish market, it is essential to ensure more affordable prices for consumers, particularly for fresh or frozen fillets. In this context, the development and adoption of technologies that enhance productivity and efficiency are essential, enabling better price adjustments without compromising fair remuneration for the various agents involved in production, processing, and distribution (Schulter & Vieira Filho, 2017).

A study by Costa *et al.* (2026) of family farmers who supply processed foods to municipal public schools through the PNAE in the micro-regions of Alto, Médio, and Baixo Jequitinhonha in Minas Gerais, Brazil, found that although family farmers recognize the importance of sanitary standards and the use of adequate infrastructure and equipment for safe food production, the practical application of these requirements still faces significant obstacles. Among the main challenges, limited financial resources stand out, followed by deficiencies in physical infrastructure, raw material availability, and technical training. Added to this are economic hurdles, such as low profitability, fierce competition, and market entry difficulties, which compromise the sustainability of activities. Given this scenario, the results indicated the need for integrated public policies encompassing financial support, qualification, technical assistance, and expanded market access to promote productive inclusion and sustainably strengthen family farming in the analyzed municipalities.

Under these conditions, legislation becomes formally valid yet materially inapplicable, contributing to the fragmentation of the production chain and the isolated treatment of its different links by public policies. In contrast, effective governance, anchored in consistent, coordinated, and enforceable legal frameworks, is central to creating an institutional environment that fosters productive inclusion and formalization and attracts investment to the aquaculture sector (Food and Agriculture Organization of the United Nations, 2022).

Therefore, articulation among the various laws and policies that regulate the fish production chain is essential to promote their integration and adaptation to the specificities of family fish farming. Such an approach is necessary to strengthen local and institutional markets, expand food and nutritional security, and promote environmentally sustainable, socially just, and economically viable family aquaculture.

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Implementation of a fish processing facility for family fish farming

Another structural challenge identified among the interviewed family fish farmers concerns limitations in infrastructure and operational capacity for slaughtering, processing, and subsequent marketing of fish. These limitations create critical bottlenecks in the production chain, restricting small-scale producers' entry into formal and institutional markets and compromising value addition, food security, and the economic sustainability of the activity (Santos, 2025).

The lack of properly certified processing units drives fish farmers into informality because, under current sanitary legislation, marketing fish becomes legally impossible without processing in establishments authorized by official inspection systems. This condition significantly limits access to institutional markets, such as the PNAE and the PAA, which require fish to be processed in facilities with sanitary registration, thereby ensuring minimum standards of quality, traceability, and food safety.

According to the Current Scenario of Aquaculture Chain Links in the State of Tocantins (Governo de Tocantins, 2023), there are six fish processing and treatment units in operation or registered, located in the municipalities of Almas (Frigorífico de Pescados Piracema), Porto Nacional (Frigorífico Barra Mansa Pescados and Aqua Piscicultura Familiar), Aliança do Tocantins (Frigorífico Bonutt Fisher), and Paraíso do Tocantins (Paraíso Pescados). Notably, all these units are privately owned, and there are no public or cooperative processing facilities geared toward serving family fish farming within the analyzed territorial scope. Furthermore, none of these units is located in the municipality of Palmas, the capital of Tocantins, which imposes high logistical costs on local fish farmers due to fish transport, contracting processing services, and losses from the product's high perishability, especially over long-distance routes.

These restrictions, in part, explain why the analyzed associations are unable to access institutional markets, as the research found that none of the three organizations can currently supply fish to the PNAE or the PAA. The lack of adequate infrastructure for fish processing is a determining factor in the productive exclusion of these family farmers. Notably, to implement these agro-food policies, the delivery of boneless fish is recommended for sanitary, operational, and food-safety reasons, and it must be obtained through processing operations carried out exclusively in authorized establishments, which reinforces the central role of processing infrastructure for productive inclusion.

Among the three associations studied, only Bom Peixe has street markets as its primary sales channel. Because it is located close to the capital, Palmas, the fish farmers travel to distribute their production. However, according to participants' reports, the roads used are poorly maintained and in unsatisfactory condition, and the infrastructure

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needs improvement. Regarding the distance traveled to distribute production among the family fish farmers of the three associations, 65% reported it to be medium to high, and 25% are closer to the marketing channel, as shown in Figure 1.

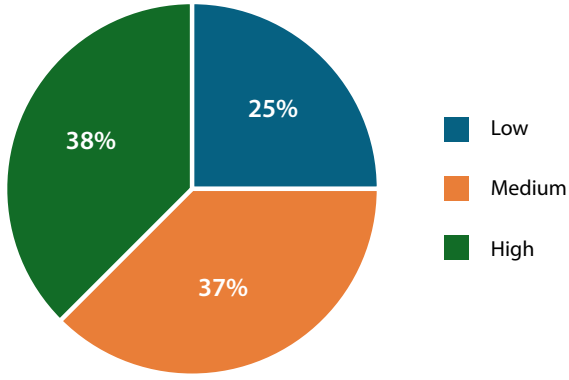

Figure 1. Distance traveled to market production. *Source:* Own elaboration based on research data, 2025.

When fish farmers do not transport the product themselves, it is generally sold directly on the property or negotiated for sale with middlemen, who then become responsible for transportation.

In this scenario, the strategic need to establish a public or collective-use fish-processing facility, preferably in the Palmas region, becomes clear to directly serve family fish farmers around Palmas Lake and nearby municipalities in the Central region of Tocantins. Providing this infrastructure would strengthen the fish production chain by enabling traceability, compliance with sanitary and certification requirements, product standardization, value addition, and expanded access to differentiated and institutional markets. Furthermore, a public processing facility can serve as a structuring public policy instrument, promoting socio-productive inclusion, territorial economic revitalization, and greater resilience in local aquaculture systems.

Public technical assistance and access to financing policies

The analysis of empirical data demonstrated the centrality of technical assistance and rural extension services for family fish farmers' access to public policies, especially those related to credit, financing, and entry into formal markets. It was observed that technical guidance serves as a mediator between producers and available institutional instruments, directly influencing productive organization, compliance with legal requirements, and the formalization of the activity.

Thus, the analysis showed that greater investment in technical training for family fish farmers is paramount, encompassing not only proper management practices but also knowledge of collective enterprise management and marketing strategies.

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These formative actions can help reduce inequalities in access to public policies by making fish farmers more capable of using support mechanisms and better prepared to compete in the market (Sousa *et al.*, 2025b).

According to the research results, all fish farmers interviewed across the three associations receive technical assistance from the "Sistema S" (S-System) through the National Rural Learning Service (Senar; *Serviço Nacional de Aprendizagem Rural*). However, in the Bom Peixe and Peixe do Segredo associations, some fish farmers also reported relying on technical support from the Rural Development Institute of Tocantins (Ruraltins; *Instituto de Desenvolvimento Rural do Estado do Tocantins*), the state agency responsible for public technical assistance and rural extension. In contrast, among fish farmers interviewed in the association in Brejinho de Nazaré, none reported receiving technical support from the state government.

This differentiation was evident in access to credit and financing. In associations that benefited from the actions of a rural extension agency, access to financial resources was higher: 62% of fish farmers in the Bom Peixe association and 25% in the Peixe do Segredo association reported obtaining some form of loan or financing. In contrast, in the Brejinho de Nazaré association, where public technical assistance was absent, no fish farmer reported access to credit. Additionally, this association had the lowest number of producers registered in the CAF Registry, underscoring the importance of technical assistance for document regularization and integration into public policies.

These results provide evidence of the strategic role of public technical assistance as an incentive for accessing financing and marketing policies, thereby contributing to production improvements, strengthening production unit management, and expanding market opportunities. Technical guidance is equally fundamental to accessing institutional markets, since the bureaucracy associated with administrative, sanitary, and fiscal procedures was identified as one of the main difficulties faced by family fish farmers. In this context, technical assistance can offer qualified support for organizing documentation, complying with legal requirements, and operationalizing sales to programs such as the PNAE and the PAA. For this support to be effective, it is essential that the state's technical assistance be continuous, systematic, and territorially articulated.

Final considerations

The results of this study indicate that family fish farming in Tocantins faces structural, institutional, and regulatory challenges that constrain its potential to contribute to sustainable rural development, food security, and socio-productive inclusion. These obstacles are primarily linked to excessive bureaucracy, especially in production and processing operations; a limited supply of qualified technical assistance; and

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documentary requirements that often do not reflect producers' reality, such as those for accessing the CAF, an essential document for securing rural credit and entering institutional markets.

In this context, the need to implement public or collective fish-processing facilities is emphasized. These facilities are intended to serve fish farmers who lack their own processing infrastructure and to expand access to continuous public technical assistance and financing lines that are more accessible and tailored to the realities of family fish farming. Such measures are fundamental to strengthening the fish production chain, expanding access to formal and institutional markets, and increasing fish farmers' incomes.

Although there are initiatives to strengthen fish farming in the state, actions remain poorly coordinated among organizations, even when they share the goal of promoting aquaculture in the region. In this context, it is necessary to build effective partnerships and cooperation networks that provide a more integrated approach to the sector's demands and the state's specific realities. Such a process cannot be carried out in isolation by a single institution, underscoring the relevance of an intersectional approach to more efficiently ensure the productive inclusion of fish farmers in markets.

Thus, based on the empirical analysis conducted, it is proposed to formulate and implement public policies aimed at strengthening family fish farmers' associations and cooperatives, expanding the intersectionality, transversality, and capillarity of existing policies, and developing more inclusive regulatory frameworks that account for the diversity of aquaculture production methods and territorial specificities.

As suggestions for future research, it is recommended to deepen the analysis of the strengthening and adaptation of public policies directed at the sector, as well as the creation of mechanisms to reduce difficulties related to existing bureaucracy and to access to credit. Furthermore, the importance of comparing the challenges faced in individual marketing with those experienced by fish farmers linked to associations and/or cooperatives is highlighted.

It is also recommended that the factors limiting fish farmers' access to the CAF be analyzed. Understanding bureaucratic hurdles, difficulties in meeting formal requirements, insufficient information about the necessary procedures, and structural obstacles could inform the development of more effective strategies to expand these producers' access to public policies, thereby strengthening their productive inclusion in markets.

Among the study's limitations are the sample size and the case study's territorial specificity. Including other organizations and expanding the analysis to other territories could broaden our understanding of bottlenecks in fish farmers' entry into different

markets and the challenges to achieving rural productive inclusion, and provide a better understanding of the role of collective action, especially in collaborating to implement more sustainable and resilient food systems.

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.

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About this article

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