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ARTICLE

MULTIDIMENSIONAL DIAGNOSIS OF THE WORK OF ARTISANAL WOMEN FISHERS IN THE PARNAÍBA DELTA

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Abstract

Artisanal fishing carried out by women plays a fundamental role in food security and the socioeconomic reproduction of coastal communities; however, it continues to face historical invisibility and institutional vulnerabilities. Grounded in Ostrom's Social-Ecological Systems (SES) framework, which provides an integrated analysis of the relationships betweennatural resources, users, and the broader socio-ecological context, this study aimed to characterize the work of 126 artisanal women fishers in the Parnaíba Delta (Maranhão/Piauí, Brazil), in an area where an Environmental Protection Area (APA) overlaps with an Extractive Reserve (RESEX), and to assess the sustainability of this activity. The study adopted a mixed-methods approach, combining participant observation with the administration of a questionnaire comprising 50 attributes. The RAPFISH approach was adapted to the study context by reorganizing its components into five analytical dimensions: Environmental, Sociocultural, Recognition/Perception, Well-being/Satisfaction, and Challenges/Risks. This adaptation made it possible to address specific aspects of artisanal women fishers' work, including domestic workload, occupational vulnerabilities, institutional recognition, and social participation. The results revealed a profile characterized by low levels of formal education, limited income, and a substantial domestic workload. The Environmental dimension achieved the highest score (4.25), indicating community engagement in conservation practices and compliance with closed-season regulations. In contrast, Challenges/Risks (2.29), Well-being (2.60), and Recognition (2.79) yielded the lowest scores, highlighting occupational vulnerability, physical strain, and limited participation in decision-making spaces. It can be concluded that the sustainability of women's artisanal fishing cannot be understood solely in terms of ecological performance, but also depends on strengthening health and safety conditions, environmental justice, and access to social rights.

Keywords: Working Conditions. Sustainability. Social-ecological System. Protected Areas.

Resumo / Resumen

DIAGNÓSTICO MULTIDIMENSIONAL DO TRABALHO DE PESCADORAS ARTESANAIS DO DELTA DO PARNAÍBA

A pesca artesanal exercida por mulheres é estruturante para a segurança alimentar e a reprodução socioeconômica em comunidades costeiras, contudo enfrenta histórica invisibilidade e fragilidades institucionais. Fundamentado no referencial do Sistema Socioecológico (SSE) de Ostrom, que analisa de forma integrada as relações entre recursos naturais, usuários e contexto socioecológico, este estudo objetivou caracterizar o trabalho de 126 pescadoras artesanais no Delta do Parnaíba (MA/PI), em área de sobreposição entre uma Área de Proteção Ambiental (APA) e uma Reserva Extrativista (RESEX), e avaliar a sustentabilidade dessa atividade. A pesquisa adotou abordagem quali-quantitativa, envolvendo observação participante e aplicação de questionário com 50 atributos. A abordagem RAPFISH foi adaptada ao contexto investigado por meio da reorganização de seus componentes em cinco dimensões analíticas: Ambiental, Sociocultural, Reconhecimento/Percepção, Bem-estar/Satisfação e Desafios/Riscos. Essa adaptação permitiu contemplar aspectos específicos do trabalho das pescadoras artesanais, como sobrecarga doméstica, vulnerabilidades ocupacionais, reconhecimento institucional e participação social. Os resultados revelaram perfil marcado por baixa escolaridade, renda reduzida e acentuada sobrecarga doméstica. A dimensão ambiental alcançou o maior escore (4,25), demonstrando engajamento comunitário em práticas de conservação e respeito ao defeso. Em contraste, desafios/riscos (2,29), bem-estar (2,60) e reconhecimento (2,79) obtiveram os menores escores, evidenciando vulnerabilidade ocupacional, desgaste físico e baixa inserção nos espaços de decisão. Conclui-se que a sustentabilidade da pesca artesanal feminina não se limita ao desempenho ecológico, dependendo do fortalecimento da saúde, segurança, justiça ambiental e ampliação do acesso a direitos sociais.

Palavras-chave: Condições de Trabalho. Sustentabilidade. Sistema Socioecológico. Unidade de Conservação.

DIAGNÓSTICO MULTIDIMENSIONAL DEL TRABAJO DE LAS PESCADORAS ARTESANALES DEL DELTA DEL PARNAÍBA

La pesca artesanal realizada por mujeres desempeña un papel estructurante en la seguridad alimentaria y en la reproducción socioeconómica de las comunidades costeras; sin embargo, continúa enfrentando una histórica invisibilización y fragilidades institucionales. Fundamentado en el marco de los Sistemas Socioecológicos (SSE) de Ostrom, que permite analizar de manera integrada las relaciones entre los recursos naturales, sus usuarios y el contexto socioecológico más amplio, este estudio tuvo como objetivo caracterizar el trabajo de 126 pescadoras artesanales en el Delta del Parnaíba (Maranhão/Piauí, Brasil), en un área de superposición entre un Área de Protección Ambiental (APA) y una Reserva Extractivista (RESEX), y evaluar la sostenibilidad de esta actividad. La investigación adoptó un enfoque mixto, cualitativo y cuantitativo, que combinó la observación participante con la aplicación de un cuestionario compuesto por 50 atributos. El enfoque RAPFISH fue adaptado al contexto estudiado mediante la reorganización de sus componentes en cinco dimensiones analíticas: Ambiental, Sociocultural, Reconocimiento/Percepción, Bienestar/Satisfacción y Desafíos/Riesgos. Esta adaptación permitió incorporar aspectos específicos del trabajo de las pescadoras artesanales, como la sobrecarga doméstica, las vulnerabilidades ocupacionales, el reconocimiento institucional y la participación social. Los resultados revelaron un perfil caracterizado por baja escolaridad, ingresos reducidos y una elevada sobrecarga doméstica. La dimensión Ambiental obtuvo la puntuación más alta (4,25), evidenciando el compromiso comunitario con las prácticas de conservación y el cumplimiento de los períodos de veda. En contraste, Desafíos/Riesgos (2,29), Bienestar (2,60) y Reconocimiento (2,79) presentaron las puntuaciones más bajas, poniendo de manifiesto la vulnerabilidad ocupacional, el desgaste físico y la limitada participación en los espacios de toma de decisiones. Se concluye que la sostenibilidad de la pesca artesanal ejercida por mujeres no puede entenderse únicamente a partir del desempeño ecológico, sino que también depende del fortalecimiento de las condiciones de salud y seguridad, de la justicia ambiental y de la ampliación del acceso a los derechos sociales.

Palabras-clave: Condiciones de Trabajo. Sostenibilidad. Sistema Socioecológico. Área Protegida.

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INTRODUCTION

Artisanal fishing, whether coastal or riverine, is characterized by the fisher's direct involvement in the capture of fish and other aquatic resources, typically using simple, manual gear, and may be carried out individually or with the support of family members and other local community members (DIEGUES, 1988). In Brazil, this activity ranks among the oldest and most significant for the food security and economy of coastal and riverine communities, although it remains marked by adverse working conditions and limited institutional recognition, particularly within small-scale fisheries (DAMÁSIO; PENINNO; LOPES, 2020). In Northeastern Brazil, artisanal fishing — practiced since the pre-colonial period — constitutes a central activity for the subsistence and food security of coastal and riverine communities. It is characterized by the use of simple technologies, the fisher's direct labor, and family and community support, yet it remains marked by institutional vulnerabilities, a lack of systematic statistics, and limited recognition within public policies (LUCENA-FRÉDOU et al., 2021).

In the Parnaíba Delta Environmental Protection Area (APA), established by the Decree of August 28, 1996, and situated across the states of Piauí, Maranhão, and Ceará (BRASIL, 1996), artisanal fishing constitutes one of the territory's main sources of lilvelihood. Partially overlapping this territory is the Parnaíba Delta Marine Extractive Reserve (RESEX), established by the Decree of November 16, 2000 (BRASIL, 2000), which corresponds to approximately 9% of the APA's total area. Fishing practices in the region take place at sea, in rivers, and in mangrove areas, involving the capture of fish and crustaceans — such as crab, shrimp, and oyster —, as well as shellfish, which are essential to the subsistence and social reproduction of traditional populations (ICMBIO, 2019).

Within this territory, women's participation stands out not only for its continuous presence in the activity but also for the way this work is deeply connected with the environment and local ecological cycles. Women fishers mobilize traditional knowledge passed down across generations, shaping their practices in harmony with the sustainable use of natural resources (PAULA, 2020). This empirical knowledge, built through everyday interaction with estuaries and mangroves, contributes to the stewardship of the territory and to the maintenance of the ecological conditions necessary for the continuity of fishing (DIEGUES, 2000). Moreover, women's involvement is a fundamental part of the artisanal fishing value chain: their participation spans key stages – such as capture, processing, and marketing of the catch –, sustains the domestic economy, and contributes to food security in the face of seasonality and stock instability (LOPES; FREITAS; BEGOSSI, 2020; SANTOS; FREITAS; MACHADO, 2025). In this sense, the work performed by women fishers often serves as a pillar of daily sustenance, securing food and income in contexts of heightened socioeconomic vulnerability.

Despite this productive relevance, barriers to recognition and formalization persist, directly affecting access to rights. Literature indicates that women's labor has historically been rendered invisible in official records and frequently reduced to the status of "assistance," limiting access to professional documentation and to social security and labor guarantees (LOPES; FREITAS; BEGOSSI, 2020). In cases where a professional fisher's license is a prerequisite for accessing benefits such as the off-season insurance, the lack of formalization can deepen vulnerabilities and reinforce cycles of exclusion (REIS-FILHO et al., 2025). This situation is tied to cultural and institutional factors that shape the organization of labor in fishing. The identity of the artisanal woman fisher continues to face obstacles linked to the gender-based division of labor, which tends to recognize boat-based fishing as the primary reference for the activity while reducing the visibility of practices carried out in estuaries and mangroves (CEZAR; THEIS, 2020). This symbolic hierarchization contributes to delegitimizing activities carried out in environments traditionally associated with women, diminishing the professional recognition of these workers (HELLEBRANDT et al., 2019). Within the academic sphere as well, analyses indicate that much of the scientific production on artisanal fishing focuses predominantly on men's trajectories, which can perpetuate these omissions and limit understanding of the productive system as a whole (GERBER, 2013).

Furthermore, within community power dynamics, women tend to be excluded from formal decision-making spaces, such as fishing communities and associations, with limited participation in assemblies and organizational processes – restricting the inclusion of demands specific to infrastructure, occupational health, and access to rights (ALENCAR, 1993). Although there have been normative advances in recognizing fishing-related work beyond capture itself, with significant changes since 2009,

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gaps persist between regulation and practical effectiveness, particularly regarding recognition of the multiple stages of labor within artisanal fishing (LOPES; FREITAS; BEGOSSI, 2020).

Draft Bill No. 4,789/2024 proposes updating the National Policy for the Sustainable Development of Fisheries and, among its advances, explicitly includes women fishers in the legislation. The bill recognizes that women are engaged in different stages of the fishing activity — capture, processing, and marketing of the catch — work that is often undervalued or left unrecorded. By incorporating a gender perspective, the bill seeks to reduce inequalities in access to rights and public policy, while also encouraging women's participation in decision-making spaces (BRASIL, 2024).

Given this context, it is relevant to investigate how the work performed by artisanal women fishers is structured and to what extent this productive way of life presents conditions for long-term sustainability. Accordingly, this study aimed to characterize the artisanal fishing activity carried out by women fishers along the northern coast of Northeastern Brazil, describing their socioeconomic profile, occupational trajectory, forms of engagement, and working conditions, as well as assessing the sustainability of this activity through a multidimensional diagnosis. To this end, a descriptive analysis of sociodemographic and productive data was applied, together with an assessment based on the RAPFISH (Rapid Appraisal for Fisheries) approach (PITCHER, 1999), comprising 50 attributes distributed across five dimensions (Environmental, Sociocultural Aspects, Recognition /Perception, Well-being/Satisfaction, and Challenges/Risks), enabling the identification of patterns, vulnerabilities, and the potential for continuity of the activity within the territory.

METHODOLOGY

STUDY AREA

The research was conducted in the Parnaíba Delta region (Figure 1), encompassing two intersected protected areas: the Parnaíba Delta Environmental Protection Area (APA), established in 1996 (BRASIL, 1996), and the Parnaíba Delta Marine Extractive Reserve (RESEX), established in 2000 (BRASIL, 2000).

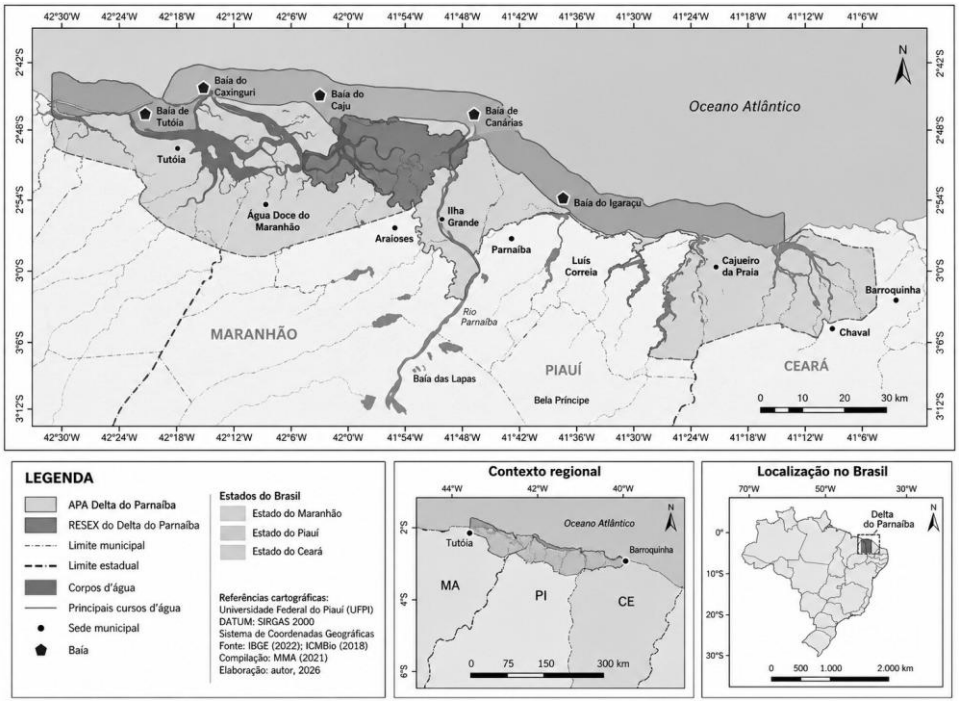


Figure 1 – Location map of the Parnaíba Delta APA. Source: Prepared by the author, 2026.

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The APA covers territories in the states of Piauí, Maranhão, and Ceará, while the RESEX comprises areas within Piauí and Maranhão. Together, these units form a coastal-estuarine ecosystem of considerable socio-environmental significance, characterized by mangroves, fluvial islands, sandbank formations, and floodplain areas, which sustain substantial biological and cultural diversity (ICMBIO, 2020).

DATA COLLECTION AND ANALYSIS

This investigation is characterized as a descriptive case study with a mixed approach (qualitative-quantitative), involving 126 artisanal women fishers. The design enabled an in-depth understanding of local dynamics and of participants' subjective experiences, while the combination of quantitative and qualitative methods allowed for the integration of measurement and interpretation of the phenomena under analysis (BUENO, 2018; MARTINS; THEÓPHILO, 2009). Field visits were conducted to the women fishers' workplaces between January and August 2026, followed by participant observation aimed at establishing rapport and understanding the context of their productive practices. Participant observation allowed direct contact with the phenomenon under study, facilitating the interpretation of the meanings women attributed to their experiences (ANDRÉ; LÜDKE, 1986; BOGDAN; BIKLEN, 1994).

As the research was carried out in federal protected areas, authorization was obtained from the Chico Mendes Institute for Biodiversity Conservation (ICMBio) through the Biodiversity Authorization and Information System (SISBIO), under authorization no. 98199-1. The study was also approved by the Research Ethics Committee under CAAE no. 95291126.1.0000.5209, Opinion no. 8,377,087. Prior to the interviews, all participants were informed of the study's objectives and procedures and expressed their agreement by signing an Informed Consent Form (ICF). Participants were selected through non-probability sampling, using the snowball technique (GOODMAN, 1961), prioritizing women aged 18 or older, residing in traditional communities in the states of Piauí and Maranhão, who engaged in fishing or fish-processing activities as their primary or supplementary source of income within the APA and the RESEX. This strategy made it possible to access informal work networks that are frequently rendered invisible (VINUTO, 2014). Interviews were conducted in person at the women's places of work or at fishing communities and associations, facilitating both data collection and direct observation of working conditions.

Ostrom's (2007) Social-Ecological System (SES) framework was adopted as the theoretical reference, as it approaches sustainability through the relationships among natural resources, their users, and the broader context in which they are embedded. This perspective was used to provide an integrated interpretation of the environmental and social dimensions of artisanal fishing performed by women in the Parnaíba Delta.

Analysis of the quantitative data began with descriptive statistics and subsequently advanced to an integrated assessment grounded in a multidimensional adaptation of the RAPFISH (Rapid Appraisal for Fisheries) approach (PITCHER, 1999). Since the method's original developers themselves endorse the substitution and refinement of attributes to more accurately capture local realities, the development of this instrument departed from generic applications of the tool. A total of 50 attributes were established across five analytical dimensions: Environmental (9 attributes), Sociocultural (15), Recognition/Perception (11), Well-being/Satisfaction (6), and Challenges/Risks (9). The Environmental dimension gathered aspects related to the use and conservation of fishery resources, management rules, and environmental conditions influencing the continuity of the activity.

The Sociocultural dimension encompassed identity, sense of belonging, knowledge transmission, and the reproduction of ways of life associated with artisanal fishing. Recognition/Perception addressed social and institutional recognition, professional identity, access to rights, and participation — aspects that are particularly relevant given the historical invisibilization of women's fishing labor (HELLEBRANDT et al., 2019; CEZAR; THEIS, 2020; LOPES; FREITAS; BEGOSSI, 2020). Well-being/Satisfaction gathered material and subjective conditions related to continued participation, while Challenges/Risks focused on occupational vulnerabilities, territorial conflicts, insecurity, and economic and institutional barriers. This organization sought to adapt RAPFISH's multidimensional principle (PITCHER, 1999) to the specificities of the object of study, without directly reproducing its

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classic fields. The distribution and description of the attributes composing each dimension are presented in Table 1.

Dimension	No.	Attribute
Environmental	1	Women fishers in your community actively participate in environmental protection.
	2	When I encounter plastic waste in the fishing environment, I try to collect it.
	3	Avoids harvesting undersized fish, shellfish, blue crabs, or mangrove crabs.
	4	Avoids fishing or harvesting species during their reproductive season.
	5	Seeks to protect the natural environment from which she derives her livelihood.
	6	Over the past five years, how do you perceive the amount of fishery resources available in your fishing area?
	7	Perceives changes in rainfall patterns that have affected her fishing activity in recent years.
	8	Is well informed about the rules and laws regulating fishing in her area.
	9	Fishery management rules are respected by most people in her community.
Sociocultural	10	Is primarily responsible for household chores in her home (cooking, cleaning, and laundry).
	11	Income from fishing alone is sufficient to provide food for her family.
	12	In the past 12 months, there has been insufficient money to purchase food.
	13	Artisanal fishing in her community provides sufficient food for her family throughout the year.
	14	Her income from fishing is sufficient to support her family.
	15	Knows about and has access to public policies or programs that support women in artisanal fishing.
	16	In her community, the work of women fishers is more highly valued than in other communities she knows.
	17	Fishing is a fundamental part of the identity and cultural life of her community.
	18	There are festivals or celebrations associated with fishing that strengthen community ties.
	19	Learned about fishing and the life cycles of aquatic animals from older generations in her family.
	20	Participates in transmitting fishing knowledge to younger generations in her community.
	21	Participates in a community decision-making body (community council, Environmental Protection Area [APA] council, or Extractive Reserve [RESEX] council).
	22	Participates in a women-only collective.
	23	Is affiliated with a fishers' colony, pastoral organization, or association.
	24	Participates in community meetings or fishers' association meetings to discuss fishing rules and problems.
Recognition/ Perception	25	Considers herself a professional fisher.
	26	Depends on a man for assistance with fishing activities.
	27	Men have more work responsibilities than women in fishing.
	28	Her fishing work is more important than the work performed by men in the community.
	29	In addition to her own activities, she also contributes to the fishing activities carried out by her partner.
	30	Participates in the manufacture and/or repair of fishing gear.
	31	Women's work in fishing is recognized within the community.
	32	Her fishing work is viewed merely as assistance or a supplementary activity rather than as essential professional work.
	33	Non-governmental organizations (NGOs) contribute positively to advancing the rights of women in fishing.
	34	Fishery management is still perceived as a predominantly male domain.
	35	Fishing rules and decisions in the community take women's needs and work into account.
Well-being/ Satisfaction	36	Has any health problem resulting from fishing activities.
	37	Fishing activity negatively affects her physical or mental health.
	38	The community has health-care infrastructure that adequately meets her needs.
	39	Experiences personal satisfaction and a sense of freedom through her work.
	40	Experiences moments of enjoyment, happiness, and social interaction.
	41	Would choose a profession other than fishing.
Challenges/ Risks	42	Feels unsafe while working because she is a woman.
	43	Experiences physical fatigue.
	44	Has experienced accidents while fishing.
	45	Has experienced hardship due to a shortage of fishery resources.
	46	Experiences health problems.
	47	Has experienced dangerous situations while fishing.
	48	Has been intimidated or prevented from fishing in certain areas.
	49	Has considered giving up fishing because of difficulties encountered.
	50	Faces difficulties accessing fishing-related rights (such as fisher registration or closed-season insurance benefits) because she is a woman.

Table 1 – Dimensions and attributes used in the multidimensional assessment of the sustainability of artisanal women fishers' work in the Parnaíba Delta (2026). Source: Prepared by the authors, 2026.

The definition of the attributes composing this analytical structure was grounded in the categories of Ostrom's (2007) Social-Ecological System, the principles of the RAPFISH approach (PITCHER, 1999), and on evidence from the literature on women's artisanal fishing, with the aim of capturing aspects relevant to the environmental, sociocultural, occupational, and institutional conditions of artisanal women fishers' work. Although the selection of attributes was theoretically based and guided by the specificities of the context investigated, no independent empirical validation of the instrument

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was carried out, such as expert-panel assessment, a dedicated pilot study for validation, or psychometric analysis of the dimensions.

This reorganization made it possible to bring together, within a single analytical structure, environmental, sociocultural, occupational, and institutional aspects related to the sustainability of women's work in the fishing industry. The contribution of this adaptation lies in the incorporation of attributes addressing dimensions that are underemphasized in classic RAPFISH applications (PITCHER, 1999), such as professional recognition, access to rights, well-being, work overload, and risks specifically associated with women's labor. Therefore, this is not the proposition of a new method, but rather the adaptation of an existing multidimensional approach to the specificities of the group and territory investigated.

This framework ensured that the indicators faithfully reflected the governance, resource-use, and vulnerability variables previously documented in the literature on women's artisanal fishing (ADIGA et al., 2015). Beyond a simple territorial adaptation, the instrument's final design preserved classic sustainability metrics while innovately incorporating indicators specifically designed to measure occupational omission and the nuances of women's labor, thereby addressing a long-standing gap in conventional fisheries assessments.

Responses were recorded on a three-point Likert-type scale, corresponding to less favorable, intermediate, and more favorable conditions with respect to sustainability (LIKERT, 1932). For the multidimensional analysis, these categories were initially coded with values from 1 to 3 and subsequently transformed linearly onto a 0-to-5 scale, according to the expression:

$$E_i = \left[\frac{x_i - 1}{3 - 1}\right] \times 5$$

where x*i* corresponds to the attribute's original score and E*i* to the standardized value. Under this transformation, the less favorable, intermediate, and more favorable conditions corresponded, respectively, to scores of 0, 2.5, and 5. For attributes formulated in the negative sense, scoring was reversed so that higher values would consistently represent conditions more favorable to sustainability.

It is acknowledged that the use of the Likert scale (1932) entails a degree of subjectivity, and that non-probability snowball sampling limits population-level statistical inference. These methodological limitations were nonetheless mitigated during analysis through mathematical linear standardization (which converted the original scale to the 0–5 interval) and through the assignment of equal weighting to all attributes. Each dimension's score was obtained as the arithmetic mean of these standardized values. The dimensional scores were then consolidated into a final matrix and represented in a radar diagram, ensuring internal consistency, simultaneous comparability across the five dimensions, and the identification of their main strengths and weaknesses. Final values ranged from 0 to 5, with higher scores associated with better sustainability conditions and lower scores with situations of greater vulnerability.

RESULTS AND DISCUSSION

PROFILE OF THE WOMEN FISHERS

An analysis of the socioeconomic profile reveals a population marked by low levels of formal education, with 46.8% of respondents reporting incomplete elementary schooling and 9.5% declaring themselves illiterate — meaning that more than half of the sample presents low formal educational attainment. This scenario may hinder access to information, professional regularization processes, public policies, services, and training opportunities, compounding vulnerabilities already associated with low income and the working conditions of artisanal fishing. Studies conducted in Northeastern Brazil likewise point to educational attainment as a persistent marker of vulnerability among fisheries workers, with repercussions for income, access to rights, and social protection (GONÇALVES et al., 2024; CAVALCANTE FILHO et al., 2022). Among women, specifically, these limitations compound the

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gender inequalities that affect professional recognition, economic inclusion, and participation in the policies and governance structures of small-scale fisheries. In communities strongly dependent on the activity, factors such as low schooling, poverty, and limited occupational alternatives also reduce the capacity to adapt to economic and environmental change (OLOKO et al., 2024).

For women, these economic conditions are also linked to the low visibility of their participation in the production chain. Although they are engaged in capture, gathering, processing, marketing, and subsistence-oriented activities, part of this work remains underestimated in statistics and in the institutional frameworks through which fishing is recognized. The Illuminating Hidden Harvests report, produced by FAO, Duke University, and WorldFish (2023), estimates that approximately 44.7 million women participate in small-scale fisheries value chains or subsistence activities, corresponding to roughly 40% of all people involved in the sector. The report also highlights that many of the activities carried out by women — particularly in land-water transition zones, in processing, and in subsistence work — remain poorly captured in official statistics, with consequences for social protection and participation in decision-making processes. When activities that are fundamental to the fisheries value chain remain poorly recognized or formalized, conditions of access to rights, benefits, and spaces for representation consequently become more fragile.

Variable	Category	n	%
Age group (years)	21–30	18	14.3
	31–40	33	26.2
	41–50	38	30.2
	51–60	24	19.0
	61–73	13	10.3
Fishing activity	Fisher (capture)	3	2.4
	Shellfish harvester	93	73.8
	Blue crab harvester	10	7.9
	Mangrove crab harvester	12	9.5
	Oyster harvester	8	6.3
Frequency of activity	A few times per week	82	65.1
	A few times per month	20	15.9
	Daily	24	19.0
Fishing environment	Rivers/estuaries	97	77.0
	Mangroves	29	23.0
	Sea	0	0.0
Time engaged in artisanal fishing	Up to 10 years	19	15.1
	10–15 years	41	32.5
	15–20 years	30	23.8
	>20 years	36	28.6
Participation in the production chain	Harvesting and processing	79	62.7
	Harvesting, processing, and marketing	47	37.3
	Harvesting only	0	0.0
Educational attainment	Illiterate	12	9.5
	Incomplete elementary education	59	46.8
	Completed elementary education	26	20.6
	Incomplete secondary education	6	4.8
	Completed secondary education	23	18.3
Motherhood	No children	7	5.6
	1–2 children	66	52.4
	≥3 children	53	42.1
Marital status	In a marital/partner union	92	73.0
	Single/divorced/widowed	34	27.0
Main source of income	Government cash transfer programs	64	50.8
	Fishing activity	51	40.5
	Retirement pensions	11	8.7
Monthly income from fishing	≤0.5 minimum wage	98	77.8
	>0.5 to 1 minimum wage	28	22.2
	>1 minimum wage	0	0.0
Purpose of fishing	Subsistence and income generation	126	100.0

Table 2 – Sociodemographic and productive characteristics of artisanal women fishers in the Parnaíba Delta (n = 126), 2026. Source: Prepared by the authors, 2026.

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Participants (n=126) ranged in age from 21 to 73 years, with a mean age of 43 (Table 2). The length of time engaged in artisanal fishing reinforces that this is not occasional participation, but rather a consolidated occupational trajectory: more than 80% of respondents have been working in this activity for over ten years, evidencing permanence and a lasting connection with the territory and with local productive cycles. This pattern is consistent with studies describing artisanal fishing as a long-term occupation, frequently associated with economic and cultural dependence on the environment and with the reproduction of traditional knowledge (GONÇALVES et al., 2024). This continuity, on one hand, sustains experience and practical mastery of the territory; on the other, it amplifies cumulative exposure to risk and precarity, reinforcing that permanence in the activity cannot be read, in isolation, as an indicator of stability.

Results regarding family arrangements show that domestic organization occupies a central position in respondents' daily routines, with direct effects on available time, physical strain, and autonomy. Although 73% of participants live with a partner, 92.9% reported being primarily responsible for household chores, revealing the persistence of a highly unequal gender division of labor. Viewed through the lens of Ostrom's (2007) Social-Ecological System framework, this extreme concentration of reproductive labor is not merely a limiting social fact or a source of physical exhaustion; it represents a high transaction cost. The need to reconcile productive activity with unpaid care work (FAO, 2023; BASTOS et al., 2023) functions as a concrete political barrier that forecloses women's participation in the governance of protected areas and in the management of common-pool resources. By consuming the time and energy required for mobilization, this overload prevents women fishers from engaging in collective-choice arenas such as assemblies and meetings of associations and fishing communities, leaving them unable to influence rule-making and the decisions that directly affect the use of the territory.

In small-scale fisheries, the effects of this overload extend beyond the domestic sphere. The need to reconcile productive work, family care, and household tasks reduces the time and availability for participation in associations, meetings, training, and other collective organizational spaces. This constraint becomes even more significant given the already limited insertion of women in fisheries management processes. In a review of 124 studies, Chambon et al. (2024) found that, among cases reporting the level of women's participation, more than 80% documented limited participation or exclusion from management processes. The unequal distribution of domestic labor may thus reinforce pre-existing barriers to women fishers' representation and to their influence over decisions concerning resource use, public policies, and working conditions.

This relationship also contributes to explain why women's high level of participation in fishing does not necessarily translate into equivalent institutional recognition. Women's contributions to small-scale fisheries remain frequently underestimated in statistics and in the sector's formal structures, despite their economic and social importance (FAO; DUKE UNIVERSITY; WORLDFISH, 2023). When productive work is compounded by a domestic workload concentrated almost exclusively among women, difficulties in political participation, collective organization, and access to opportunities capable of expanding their autonomy are correspondingly amplified. Motherhood also emerges as a structuring feature of participants'' profile. It was found that 94.4% are mothers, and 42.1% have three or more children, configuring a scenario in which caregiving responsibilities and family sustenance overlap with productive work. This finding aligns with studies describing the constant presence of motherhood in artisanal fishing and its effects on time management and work strategies within the territory, particularly where caregiving remains concentrated among women (BRITO et al., 2025; JESUS; PENA; ARAÚJO, 2023). Motherhood, more than a sociodemographic datum, helps explain how the activity is sustained within a routine of multiple demands, reinforcing the strain and the difficulty of reconciling productive continuity with basic conditions of rest and protection.

From an economic standpoint, the results show that women fishers' household sustenance depends, to a considerable extent, on sources external to the fishing activity itself. Government cash transfer programs were identified as the main source of income by 50.8% of respondents, while 40.5% cited fishing as their economic base and 8.7% cited retirement pensions. At the same time, monthly income derived exclusively from fishing does not exceed half of the minimum wage for 77.8% of participants — considering the minimum wage in effect in 2026 (R$ 1,621.00) (BRASIL, 2025) — and none reported earnings above one minimum wage, indicating a low capacity to generate financial

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stability despite a strong occupational bond with the activity. Artisanal fishing in the Northeast holds significant productive and social relevance, but is marked by low and unstable earnings, shaped by seasonality, fluctuations in fishery resources, and structural constraints on economic inclusion (LUCENA-FRÉDOU et al., 2021). Social security benefits and social policies therefore become essential to the survival and economic protection of fishing families, particularly where direct income from labor fails to ensure regularity (BASTOS et al., 2023). Economic fragility thus emerges as a critical element of the activity's sustainability, limiting investment capacity, reducing adaptive capacity, and reinforcing dependence on external mechanisms for social reproduction.

Even with low earnings, fishing does not appear as an activity restricted to a commercial logic: all respondents (100%) reported fishing both for food and to supplement income. This finding shows that, in this territory, subsistence and income generation operate in an integrated manner, with fishing playing a strategic role in food security. Recent studies and international reports recognize small-scale fisheries as a foundation of nutrition and livelihood across numerous communities, reinforcing their importance as both an economic and a cultural element (GAMARRA et al., 2023; FAO, 2024). Thus, although the activity yields low remuneration, it sustains essential dimensions of life, amplifying the impact that any environmental or productive instability would have on family food security and income.

The type of activity performed and access to productive infrastructure further underscore this vulnerability. Shellfish gathering was identified as the primary activity for 73.8% of respondents, while only 2.4% reported working in fish capture. The predominance of gathering in estuarine environments indicates work strongly tied to the tide cycle and to nearby areas, while the low ownership of boats points to material constraints that limit mobility and the expansion of fishing grounds. Studies highlight that shellfish gathering is a traditional practice widely performed by women, and that inequalities in access to equipment and technology tend to reduce productivity and economic returns in small-scale work (FAO, 2024). This work pattern shows that vulnerability extends beyond the economic dimension, constituting a structural condition related to how women's fishing labor has historically been organized and recognized. Dependence on nearby areas and absence of dedicated infrastructure reduce shellfish gatherers' capacity to respond to external pressures and environmental change, keeping the activity anchored in high physical effort and low economic return, despite its centrality to community subsistence and food security (LOIOLA et al., 2024).

Two main environments were identified as used by participants for artisanal fishing: rivers/estuaries and mangroves. Among respondents (n=126), the majority reported working in rivers and estuaries (97 responses), while a smaller share reported using mangrove areas (29 responses). No activity was recorded at sea (0 responses), indicating that the practice is concentrated in coastal transition environments. This finding is consistent with that described by Costa et al. (2022) in the area proposed for the creation of the Tauá-Mirim RESEX, in Maranhão, where the estuarine channel, the mangrove, and the estuarine region itself were identified as the central geoecological units for artisanal fishing, associated with resource availability and tidal dynamics. In the present study, the predominance of rivers/estuaries may be explained by the high productivity of these systems, formed by the interaction between fresh and salt water, which favors the concentration of commercially relevant species (MIRANDA; CASTRO; KJERFVE, 2002).

The use of mangrove areas, although less frequent among respondents, reinforces the centrality of this ecosystem to artisanal fishing, as it functions as a refuge and breeding area for aquatic organisms and is directly conditioned by the tidal regime (EWEL; TWILLEY; ONG, 1998). This importance was also observed in an ethnoecological study conducted in the Pacoti River estuary, in which artisanal fishers associated the presence and availability of resources with the physical structure of the mangrove—particularly roots, branches, and shaded areas—recognized as refuge and feeding sites. The same study also highlighted the influence of tides on the movement and distribution of organisms within the estuary (LOIOLA et al., 2022).

Supplementary catches associated with the mangrove not merely result from spatial choice but reflect the ecological dynamics of estuarine systems. Variations in tide, salinity, and turbidity reorganize access to resources and modulate fishing effort over time, reinforcing the dependence of small-scale artisanal fishing on the integrity of the mangrove as an essential ecological infrastructure of the territory (COSTA et al., 2022; LOIOLA et al., 2022).

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MULTIDIMENSIONAL DIAGNOSIS (ADAPTED RAPFISH)

The multidimensional synthesis of scores reveals an uneven pattern of sustainability, in which strong environmental performance coexists with significant social and occupational vulnerabilities . The Environmental dimension achieved the highest score (4.25), indicating a positive perception regarding the preservation and management of local resources, while Challenges/Risks (2.29) and Well-being (2.60) emerged as the most critical points, accompanied by a low-intermediate Recognition/Perception score (2.79) and a moderate Sociocultural score (3.35) (Figure 2).

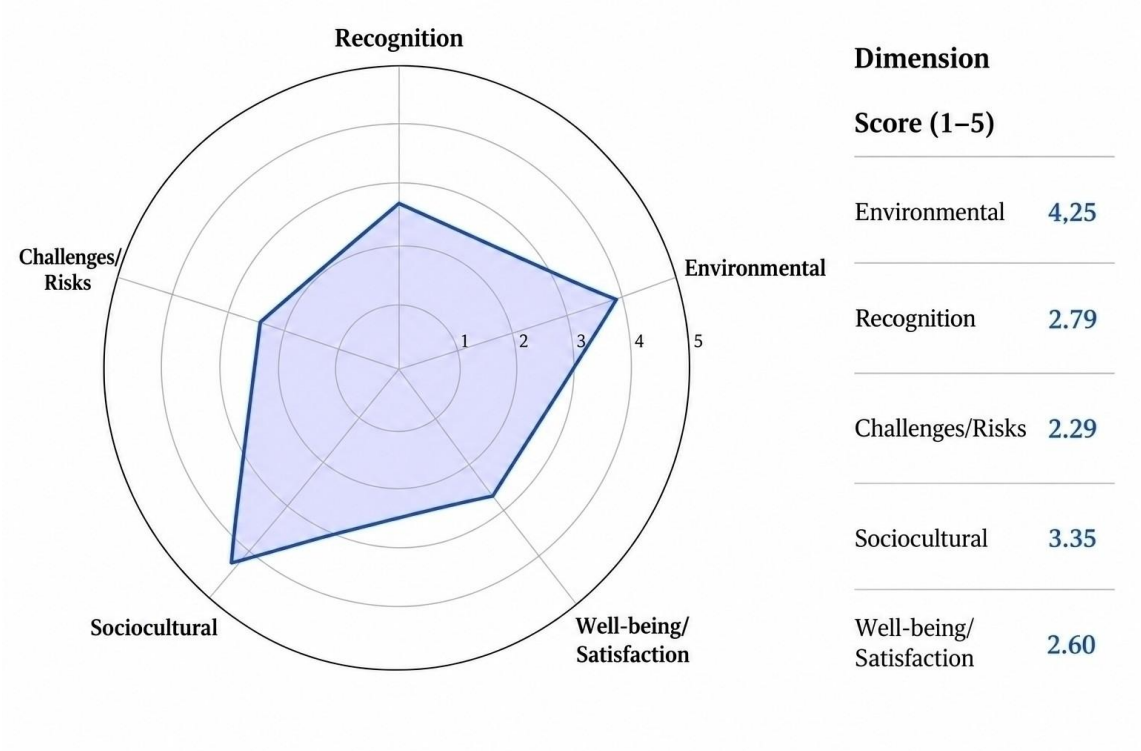


Figure 2 – Multidimensional Sustainability Radar of Women Fishers in the Parnaíba Delta (Northeastern Brazil), 2026. Source: Prepared by the authors, 2026

More than just an isolated hierarchy of scores, this configuration expresses a pattern of interdependence among the dimensions analyzed: the high level of environmental responsibility assumed by women fishers does not correspond to an equivalent capacity to influence the institutions that regulate the territory and the resources on which they depend. The multidimensionality proposed in this study, therefore, does not stem merely from the separate measurement of five dimensions, but from the interpretation of the relationships that articulate them — a relationship that constitutes the analytical axis developed in Section 3.3, in light of Ostrom's (2007) Social-Ecological Systems framework.

The high environmental score reflects unanimous (100%) responses regarding compliance with capture rules, such as closed seasons and minimum sizes limits, as well as women fishers' direct involvement in protecting the environments in which they work. These results show that respondents recognize, in practice, their role in managing the territory and understand that their choices are directly linked to the continuity of the fishing activity. Studies indicate that women's presence in small-scale fisheries tends to strengthen more sustainable practices and environmental protection attitudes, particularly in territories with strong community bonds and accumulated knowledge of ecological cycles (LOPES; FREITAS; BEGOSSI, 2020; MACUSI et al., 2023; CHAMBON et al., 2024).

Reviews of research on women in fishing communities confirm that this traditional knowledge is expressed in the daily management of resources, guided by careful gathering practices and respect for natural rhythms, constituting an important basis for environmental conservation (SOUZA; RIBEIRO;

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MARTÍNEZ, 2019). The lowest score was observed in the Challenges/Risks dimension (2.29), followed by a similarly low result in Well-being (2.60), which together configures a picture of persistent vulnerability. These values indicate that women fishers' work unfolds under conditions of insecurity and physical strain, with direct effects on the continuity of the activity, health, and economic stability. Recent literature points out that vulnerabilities associated with artisanal fishing may involve situations of violence, intimidation, and harassment throughout the value chain, in addition to occupational risks arising from contact with unhealthy environments and from repetitive, physically demanding tasks (MANGUBHAI et al., 2023; FLORES et al., 2024).

These findings indicate that such risks are not isolated occurrences, but arise within contexts marked by territorial conflict, external pressures, and institutional weakness. A study conducted in Brazilian fishing communities shows that the intensification of disputes over the use of coastal and estuarine spaces — linked to the expansion of economic activities and to the state's limited capacity for mediation — contributes to heightened everyday insecurity, emotional strain, and instability in women's fishing labor (SANTOS; MELO E SOUZA, 2019). From a political ecology perspective, these processes take on a structural character, as they restrict access to territories and resources, reinforcing pre-existing social, productive, and economic vulnerabilities (WALTER et al., 2019).

Compounding this picture is the nature of the work itself, frequently marked by repetitive tasks, prolonged exposure to unhealthy environments, and a lack of adequate protection — factors that favor illness, exhaustion, and chronic pain, with direct impacts on well-being and on women's capacity to remain in the fishing activity (HELLEBRANDT et al., 2019).

Domestic overload also helps explain the low Well-being and Challenges/Risks scores, since fishing activity is layered atop domestic and caregiving responsibilities already concentrated among women (FAO, 2023; BASTOS et al., 2023).

The Recognition/Perception indicators, with a score of 2.79, demonstrates that these fragilities are not confined to material conditions but also involve symbolic and institutional obstacles that run through these workers' everyday lives. This result suggests low perceived valorization and limited access to spaces of participation and decision-making, which may directly influence the realization of rights and support policies. Institutional recognition of artisanal fishing labor remains uneven, with effects on professional identity and access to benefits, particularly where women's labor is concentrated in less visible activities (ARAÚJO; PINHO, 2024). The Recognition dimension thus emerges as an element that weakens overall sustainability, as it limits capacity for organization, representation, and social protection.

In light of Ostrom's (2007) perspective, this limitation is significant because the sustainability of social-ecological systems depends not only on the existence of rules, but also on collective-choice arrangements that allow directly affected users to participate in defining and modifying them. In the case of women fishers, direct dependence on fishery resources and on the territory does not imply equivalent participation in decision-making spaces. Low institutional recognition and limited insertion in participatory processes may therefore reduce their capacity to influence norms, access rights, and defend interests related to resource use and to the continuity of the fishing activity.

Women fishers' participation must also be distinguished between formal presence and substantive participation. Affiliation with fishing communities, associations, or other institutional spaces does not necessarily entail an effective capacity to influence agendas, rules, or decisions. Institutional inclusion can coexist with limited representation of women's specific demands, particularly those related to working conditions, access to rights, and territorial use. Analyzing participation therefore requires considering not only women fishers' presence in these spaces, but also their capacity to exercise voice and influence over decisions that directly affect their activity and their ways of life.

Another relevant aspect concerns the articulation among the different institutional levels involved in managing fishing and the territory. In complex social-ecological systems, Ostrom (2007) highlights the importance of coordination among local organizations, community bodies, and public institutions. In the context studied, the sustainability of women's fishing activity also depends on the articulation among fishing colonies, associations, protected areas, and the agencies responsible for resource management and for access to rights.

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The Sociocultural dimension achieved a score of 3.35, indicating a strong presence of fishing within community identity and knowledge transmission. This is expressed in the high levels of agreement that fishing is a fundamental part of local culture (86.5%), as well as in intergenerational learning (82.5%) and in participation in knowledge transmission (78.6%). These results show that artisanal fishing constitutes a way of life built through communities' everyday practice, grounded in practical knowledge, accumulated experience, and knowledge passed down across generations (GARCEZ; SÁNCHEZ-BOTERO, 2005; BASÍLIO; GARCEZ, 2015). However, 75.4% of respondents reported not being aware of, or not having access to, public policies aimed at women in fishing, evidencing a disconnect between institutional support and local everyday life.

SUSTAINABILITY, TERRITORY, AND GOVERNANCE OF THE SOCIAL-ECOLOGICAL SYSTEM

A comprehensive analysis of the results presented in Section 3.2 goes beyond an isolated comparison of scores, allowing for an integrated interpretation grounded in Ostrom's (2007) Social-Ecological Systems (SES) framework. From this perspective, the five dimensions analyzed configure articulated layers of a single territoriality: the Environmental dimension reflects the ecological territory (ecosystems and their cycles); the Sociocultural, the lived territory (identity and knowledge transmission); Recognition/Perception, the political territory (participatory legitimacy and governance); Well-being/Satisfaction, the territory of labor (the body and occupational health); and Challenges/Risks, the contested territory (tensions over use).

These dimensions do not operate in isolation; rather, they define the dynamics of the Parnaíba Delta's social-ecological system. The resource system (the estuaries and mangroves of the APA and the RESEX) and its resource units (fish, shellfish, crustaceans) interact continuously with users (women fishers, tourism operators) and with the governance system (ICMBio, fishing colonies, councils, management rules). The central finding emerging from this web of interactions is that the instability of the system lies not in women fishers' willingness to conserve common-pool resources, but in the clear socio-ecological mismatch between their high level of environmental responsibility (score: 4.25) and their low capacity to influence the institutions that govern the territory (Recognition: 2.79; Challenges/Risks: 2.29).

TERRITORY AND DEPENDENCE ON THE COMMONS

From the standpoint of direct resource dependence, the socioproductive data illustrate this territorial relationship. Among respondents, 77.0% carry out their activity in rivers and estuaries and 23.0% in mangroves, with no activity recorded in marine environments. These results show that women fishers' work is concentrated in estuarine and mangrove environments, which hold ecological importance while also functioning as spaces of production, sustenance, culture, and identity. This constitutes a strongly localized appropriation of common-pool resources, in which the continuity of the activity depends on access to these environments, on accumulated knowledge of tides and reproductive cycles, and on the maintenance of the rules governing their use. These elements, in Ostrom's (2007) framework, form the foundation upon which resource systems and their constituent units are structured.

POWER RELATIONS AND SOCIOENVIRONMENTAL CONFLICTS

This territorial dependence also increases women fishers' vulnerability to disputes over the use of space. Although the questionnaire applied did not include specific questions on tourism, observations made during fieldwork identified conflicts between artisanal fishing and tourism and recreational activities in the estuarine channel — particularly kitesurfing in certain stretches and times, and the intensification of tourist motorboat traffic. Increased wave action, bank erosion, and heightened insecurity were recorded for small vessels, such as the canoes used by respondents. A similar situation has been observed in other Brazilian Marine Extractive Reserves, where the expansion of tourism reconfigures coastal spaces and generates disputes over access, circulation, and the permanence of artisanal fishing (MENDONÇA; MORAES; COSTA, 2013).

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From the perspective of "Blue Justice" — an approach that examines power asymmetries in the appropriation of coastal territories (BLYTHE et al., 2023) — these episodes should not be interpreted as isolated inconveniences, but as expressions of unequal capacities for appropriation and circulation within the same territory. When tourist boats and water-sports practitioners occupy areas traditionally used by artisanal fishing, what is at stake is not merely physical space, but each group's differentiated capacity to access, use, and shape the ordering of the territory. For women fishers who depend on small vessels and on empirical knowledge of the tides, the loss of autonomy of movement and of safety in historically occupied areas constitutes a process of territorial exclusion that threatens the social reproduction of their livelihoods and diminishes traditional communities' influence over decisions affecting the territory and its commons (REIS-FILHO; HATJE; BARROS, 2024). Such processes of spatial reordering and intensified use of the coastal space, when unaccompanied by mediation mechanisms, tend to restrict small-scale fishers' access to historically used areas, compromising livelihoods, safety, and socio-ecological well-being (BENNETT; GOVAN; SATTERFIELD, 2015).

WOMEN'S PARTICIPATION AND GOVERNANCE OF THE COMMONS

The capacity to address territorial conflicts depends, in part, on women fishers' effective participation in the spaces where rules governing the use of resources and territory are defined. In Ostrom's (2007) framework, the sustainability of common-pool resource systems is associated with the existence of collective-choice arrangements that ensure directly affected users the possibility of participating in the elaboration and modification of such rules. The results of this study indicate, however, that this condition holds only to a limited extent. The low score for the Recognition/Perception dimension (2.79) — composed of attributes related to participation in community councils, women's collectives, fishing colonies, and associations, as well as the perception of fisheries management as a predominantly male-dominated space — suggests an asymmetry between resource dependence and the capacity to influence its governance. Although women fishers depend directly on these environments for the maintenance of their livelihoods, this dependence does not necessarily translate into proportional participation in decision-making processes. This asymmetry is significant because the participation of users in rule-making constitutes one of the principles associated with the durable governance of common-pool resources, particularly when those directly affected have real conditions under which to influence decisions and adapt norms to local specificities (OSTROM, 1990).

This limitation is also linked to the division of domestic responsibilities. As discussed in Section 3.1, 92.9% of respondents reported being primarily responsible for household chores. From the perspective of common governance, this overload constitutes not merely an indicator of gender inequality, but a mechanism that constrains the substantive participation of women fishers in collective-choice arrangements. By consuming the time and energy required for involvement in assemblies, meetings, and councils, unpaid reproductive labor reduces women's capacity to influence rule-making and to respond to the territorial conflicts affecting their activity. A relationship is thus established among the sexual division of labor, political participation, and capacity to respond to external pressures: domestic overload reduces the time available for participation; low participation diminishes influence over the rules governing territorial use; and, as a consequence, responding to the socioenvironmental conflicts discussed above becomes correspondingly more difficult.

APA-RESEX OVERLAP AS INSTITUTIONAL COMPLEXITY

The territorial overlap between the Parnaíba Delta APA and RESEX adds further complexity to this governance system. The RESEX corresponds to approximately 9% of the APA's total area, such that women fishers carry out their activities within a territory subject to different instruments of protection, management, and participation. These bodies hold their own mandates and decision-making arenas, which do not always correspond to the everyday forms of space use.

It should be noted, however, that the research design did not include instruments capable of measuring whether women fishers distinguish, in practice, between the specific rules of each protected area, nor does support claims regarding the existence of normative conflicts as perceived by

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respondents. The overlap should therefore be interpreted as a complex institutional context, marked by the simultaneous operation of different rules, actors, and institutions over the same territory. In contexts of this nature, articulation across levels of organization and connections among actors, knowledge systems, and institutions are essential to adaptive forms of natural resource co-management (BERKES, 2009). This articulation also constitutes a relevant element for the sustainable governance of complex social-ecological systems (OSTROM, 2007).

CONCLUSION

This study on the multidimensional diagnosis of artisanal women fishers' work in the Parnaíba Delta demonstrates that the sustainability of traditional coastal livelihoods extends beyond the strictly biological dimension or the isolated measurement of ecological indicators. Viewed through the lenses of Social-Ecological Systems (SES) and Blue Justice, the research shows that the fishing territory — situated at the intersection of an Environmental Protection Area and the Marine Extractive Reserve — constitutes a space of social dispute, within which women's labor serves as a fundamental pillar of socioeconomic reproduction and community food security.

The adapted application of the RAPFISH method (PITCHER, 1999) revealed a heterogeneous multidimensional diagnosis. The strong performance of the Environmental dimension reflects community engagement with formal and informal conservation rules, such as compliance with closed seasons and the use of low-impact techniques. In contrast, the fragilities recorded in the Well-being, Challenges/Risks, and Recognition dimensions expose these workers' occupational vulnerability. Domestic overload, the physical strain inherent to shellfish gathering, and a lack of social protection constitute structural barriers to the reproduction of the fishing way of life.

The territorial analysis indicates that the unregulated expansion of tourism and recreational activity in the estuary — evident in motorboat traffic and kitesurfing — generates direct socioenvironmental impacts on traditional fishing grounds, causing bank erosion and the displacement of aquatic fauna. This scenario intensifies territorial conflicts and superimposes the market logic of the coastal space onto community uses. It is also worth noting the gap between women's formal affiliation with fishing colonies or associations and their effective decision-making capacity within local forums, which perpetuates gender asymmetries in the governance of common-pool resources.

From a methodological standpoint, the research demonstrates the feasibility of adapting RAPFISH (PITCHER, 1999) to incorporate gender dimensions and women's labor into sustainability diagnostics. As study limitations, the non-probabilistic nature of the sampling and the subjectivity involved in local actors' valuation of the attributes should be noted, both of which call for caution in extrapolating these findings to other estuarine contexts without appropriate regional adjustments.

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DATA AVAILABILITY

Not applicable.

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ARTICLE

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Garcez, D.S. - The author contributed to the elaboration, data analysis, and writing.

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Use of AI

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