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Original Article

Participatory Diagnosis in Artisanal Fishing Communities of the Colombian Magdalena Medio Region

Diagnóstico participativo en comunidades pesqueras artesanales del Magdalena Medio Colombiano

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Abstract

Introduction: Rural fishing communities face multiple challenges, including employment instability, illegal fishing, and inadequate infrastructure, which undermine their well-being and sustainability.
Objective: To identify the needs and potential of rural fishing communities through a participatory rural appraisal to better understand their socioeconomic and environmental conditions.
Methodology: A qualitative, non-experimental approach was adopted using participatory workshops that incorporated brainstorming, the Regnier Abacus, and process flowcharts to collect fishers' perceptions and promote discussion of their local realities.
Results: Structural barriers related to employment instability, illegal fishing, inadequate infrastructure, limited resources, and insufficient institutional support were identified. Fishers expressed concern about the sustainability of their livelihoods and the need to improve their living conditions. Opportunities were also identified to strengthen community organization, diversify productive activities, and establish direct marketing channels.
Conclusions: The findings support strategies aimed at strengthening community organization, promoting economic diversification, and addressing the challenges identified during the participatory process. They also highlight the need for differentiated public policies that recognize the territorial complexity of artisanal fishing systems and promote sustainable and inclusive local development through the active participation of communities in decision-making. These findings provide a reference for actions to strengthen the artisanal fisheries sector.

Keywords: artisanal fishing; food security; rural economy, fishing communities.

Resumen

Introducción: Las comunidades rurales pesqueras enfrentan problemáticas que limitan su desarrollo, entre ellas la inestabilidad laboral, la pesca ilícita y la falta de infraestructura, lo que afecta su bienestar y sostenibilidad.
Objetivo: Identificar las necesidades y potencialidades de las comunidades rurales pesqueras mediante un diagnóstico rural participativo, con el fin de comprender sus condiciones socioeconómicas y ambientales.
Metodología: Se empleó un enfoque cualitativo no experimental, basado en talleres participativos que incorporaron herramientas como lluvia de ideas, el ábaco de Regnier y flujogramas de proceso, permitiendo recoger las percepciones de los pescadores y promover la discusión sobre sus realidades.
Resultados: Se evidenciaron barreras estructurales relacionadas con la inestabilidad laboral, la pesca ilícita, la falta de infraestructura, recursos y apoyo institucional. Los pescadores manifestaron preocupación por la sostenibilidad de sus actividades y la necesidad de mejorar sus condiciones de vida. Asimismo, se identificaron oportunidades para fortalecer la organización comunitaria, diversificar las actividades productivas y establecer rutas de comercialización directa.
Conclusiones: Los hallazgos orientan la formulación de estrategias enfocadas en el fortalecimiento organizativo, la diversificación económica y la atención de las problemáticas identificadas durante el proceso participativo. Además, se destaca la necesidad de políticas públicas diferenciadas que reconozcan la complejidad territorial de los sistemas pesqueros artesanales y promuevan procesos de desarrollo local sostenibles e inclusivos, con participación activa de las comunidades en la toma de decisiones, aportando elementos de referencia para el fortalecimiento del sector pesquero artesanal.

Palabras clave: Economía rural; pesca artesanal; seguridad alimentaria, Comunidades pesqueras.

How to cite?

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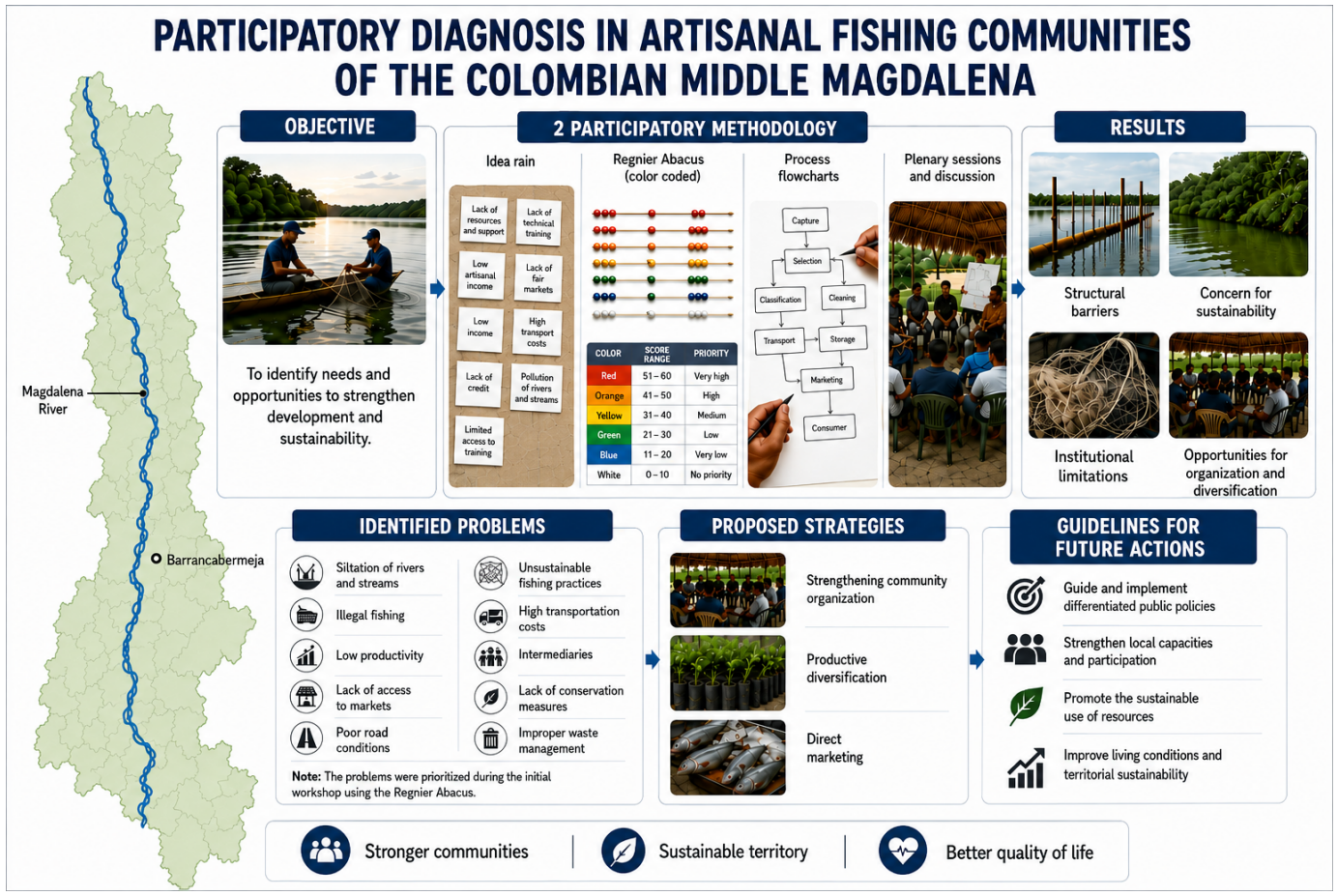
Why was this study conducted?
This study was conducted to identify, through a participatory rural appraisal, the main needs, challenges, and potential of artisanal fishing communities in Colombia's Magdalena Medio region. The research sought to understand the social, economic, environmental, and productive conditions that influence the sustainability of these communities, incorporating the knowledge and experience of fishermen as the basis for formulating territorial development strategies.

What were the most relevant findings?
The results showed that the main constraints facing the sector include illegal fishing, sedimentation of water bodies, informal employment, deteriorating infrastructure, limited institutional support, and difficulties accessing markets. Furthermore, the study identified that strengthening community organization, providing technical training, adopting sustainable technologies, and diversifying productive activities are essential factors for improving the competitiveness and sustainability of artisanal fisheries.

How do these findings contribute?
The findings provide a technical and participatory foundation to guide the formulation of strategies, programs, and public policies aimed at strengthening the artisanal fisheries sector. Furthermore, they help promote community organization, sustainable management of fishery resources, economic diversification, and coordination among communities, institutions, academia, and local stakeholders, thereby fostering more inclusive and sustainable rural development.

Graphical Abstract



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Introduction

Artisanal or small-scale fishing plays a fundamental role in territorial development, food security, economic growth, and poverty reduction by generating direct and indirect employment for communities (1,2). Worldwide, this activity engages approximately 50 million fishers, accounting for 90% of all capture fisheries workers (1,3). It also sustains the livelihoods of more than 200 million people, particularly in developing countries, where 97% of the population linked to the sector is concentrated (4,5). These figures reflect the economic and food-related dependence of large population groups on this activity, whose catches reach up to 74% in Latin America and the Caribbean, 70% in Asia and Oceania, and 24% in Europe (5,6).

At the national level, artisanal fishing accounts for 50% of total catches, making it a significant contributor to the domestic food supply, both for food security programs and for the country's production indicators (5,7). Although this type of fishing contributes less than 0.2% of Colombia's Gross Domestic Product (GDP), 85% of the fish consumed in households comes from small-scale fishing, with per capita consumption ranging between 5 and 10 kilograms per year (8–10). These figures highlight the importance of artisanal fishing in Colombia for food availability, the livelihood of numerous families, and local economies. In this regard, artisanal fishers allocate most of their catch to self-consumption and sell the remainder, thereby contributing to rural household subsistence and food availability, since they take part in catching**,** unloading, processing, distribution, and marketing activities. Its relevance therefore lies not only in income generation but also in its contribution to the food security of these communities (11,12).

This production chain is also considered highly vulnerable to climate change, since its effects reduce fish stocks, leading to income losses that affect the quality of life of those who depend on this activity (13). In addition, factors such as overfishing, an aging rural population, a shrinking labor force, ecosystem degradation, the unchecked expansion of aquaculture, the lack of technical guidance, the absence of good aquaculture practices, limited participation in marketing channels and value-added activities, and inadequate or nonexistent technical training all contribute to poor and informal decision-making (7,14). As a result, this sector often becomes a last-resort livelihood strategy or a buffering mechanism for populations most affected by unemployment, precarious conditions, conflict, and geographic isolation (15). Together, these factors limit the sustainability of fishing activity and deepen the vulnerability of the communities that depend on it. Addressing these challenges therefore requires sustainable fisheries management strategies and community-strengthening efforts to ensure participatory governance aimed at improving the living conditions of the communities linked to this activity (16).

Adequately describing artisanal fishing requires a wide range of data and information that is frequently lacking in this sector, historically identified as "data-poor" (17). This relatively understudied productive link therefore calls for a region-by-region analysis capable of recognizing community participation and grounded in empowerment, self-organization, and context specificity (18,19). Under this approach, local groups' knowledge can provide relevant input for planning, needs identification, and sector management, while also fostering recognition of, and dialogue between, different knowledge systems (20,21). Accordingly, it is essential to gather information on

doi: 10.25100/iyc.v28i2.15612

the socioeconomic situation of fishing populations, as well as to describe their characteristics and fishing techniques, in order to generate reference data that supports the planning of traditional fishing (6).

In light of the foregoing, the objective of this study is to identify the needs, resources, and potential of the fishing communities of the Barrancabermeja District, Santander, Colombia, through participatory methodologies, with particular focus on the corregimientos of El Llanito and San Rafael de Chucurí, where the population depends primarily on artisanal fishing. Building on this diagnosis, the study proposes collaborative solutions that integrate local knowledge into decision-making, aimed at developing strategies to address the socioeconomic and environmental challenges identified within the fishing communities.

Materials and methods

This research was conducted in Barrancabermeja, in the department of Santander, Colombia, covering several fishing communities located in the rural corregimientos of El Llanito and San Rafael de Chucurí. The study area is surrounded by the Magdalena River and numerous wetlands, which support economic activities such as fishing and river transport. This habitat supports a wide variety of fish species, including those that migrate and reproduce in these waters (22). Geographically, the area is located at an altitude of approximately 75 meters above sea level, with annual rainfall of 3,100 mm, resulting in a tropical climate characterized by temperatures ranging between 25°C and 30°C (23).

Population and Sampling

The study population comprised the members of three fishing associations: Asociación de Pescadores y Acuicultores del Llanito (APALL, Fishers' and Aquaculturists' Association of El Llanito), Asociación de Pescadores Artesanales del Magdalena Medio (ASOPESAMM, Magdalena Medio Artisanal Fishers' Association), and Asociación de Pescadores de San Rafael de Chucurí (ASOPESCHUCURÍ, San Rafael de Chucurí Fishers' Association). The fishing communities were selected through purposive, non-probabilistic cluster sampling, following the methodology proposed by Otzen and Manterola (24) and Sánchez Gómez et al. (25). Under this method, subject selection is not based on probability but on the specific characteristics of the study and the researcher's judgment, drawing on direct observation. Selection criteria proposed by Castillo & Baigún (20) and Paz-Díaz et al. (26) were applied and adapted for the study, as follows:

Inclusion criterion: members actively participating in the fishing associations who, at the time the workshops were held, were available and willing to participate.

Exclusion criterion: association members who showed no interest in or availability for the participatory workshops, as well as individuals who did not belong to a fishing association or who were not engaged in fishing on an exclusive or semi-exclusive basis.

doi: 10.25100/iyc.v28i2.15612

Mobility criterion: available resources for travel, including the availability of transportation, fuel, accessible routes, and the time required to reach the selected locations.

Sample: Once the inclusion, exclusion, mobility, and access criteria had been met, the total sample comprised 60 association members across the two (2) corregimientos under study, with 20 from APALL, 21 from ASOPESAMM, and 19 from ASOPESCHUCURÍ.

Methodological Phases

This study is qualitative and interpretive in nature and is classified as non-experimental, cross-sectional, and descriptive, characterized by observing phenomena within their natural setting, following the methodology established by García & La Serna Palomino (27). Its descriptive character makes it possible to detail the social, environmental, economic, and productive dimensions of artisanal fishing through a participatory diagnosis, promoting community participation and generating contextualized explanations enriched by local perspectives (28,29). Fieldwork was carried out between August 1 and December 15, 2023, through five participatory workshops and one results-sharing session. Participatory Rural Appraisal (PRA) was used as the main data-collection tool, with emphasis on artisanal fishers' perceptions (30). The research followed a three-phase methodological structure:

Phase I. This phase sought to identify the main obstacles to rural development in the fishing communities. Two participatory tools were used brainstorming and the Regnier Abacus covering the social, environmental, economic, and productive dimensions of the associations under study. These tools were adapted to design a participatory workshop based on the contributions of Geilfus (31) and Martelo et al. (32), as shown in Table 1**.** The problems identified through brainstorming were subsequently assessed individually by participants using the Regnier Abacus, allowing the establishment of levels of consensus based on the frequency and intensity of the ratings obtained.

Table 1. Participatory Action Tools

Data-collection technique	**Description**
Brainstorming	Enables the rapid collection of relevant information by working with a small group of people directly involved in the problem under study. Topics are addressed openly, with the aim of gathering all participants' ideas and perceptions.
Regnier Abacus	This method quickly gathers and analyzes responses, simplifying debate and the exchange of ideas. The color scale used includes light green, yellow, light red, red, and white, providing insight into individual opinions. Its advantage lies in **identifying** group opinion while revealing each participant's individual assessment, which helps identify areas of consensus and dissent.

doi: 10.25100/iyc.v28i2.15612

Phase II. This phase identified the elements that contribute to improving rural competitiveness factors, following the approaches of Barboza et al. (33) and Ramírez García & Camacho Bercherlt (34). An activity flowchart was built for the economic and productive dimensions a strategic graphical tool that draws on collective input to visualize the multiple cause-and-effect chains related to a context of interest, distinguishing between root problems and their consequences and identifying the critical nodes where activities and decision-making converge to carry out a given productive activity (35).

Phase III. This phase represents a stage of socialization and participatory strategy-building aimed at addressing the challenges identified during the diagnosis. The plenary session was used as the primary tool for listening to the community, understanding its difficulties, and drawing on its knowledge of the topics addressed. Using the data obtained, the process moved forward through the formulation of competitive strategies, put forward as proposals for concrete, sustainable solutions grounded in the methodologies consulted (36–38).

Information obtained through brainstorming, the Regnier Abacus, the flowcharts, and the plenary sessions was recorded on flip charts and physical formats during each participatory session. These records were subsequently systematized in Excel matrices and organized according to the social, environmental, economic, and productive dimensions previously defined for the study, drawing on criteria considered in previous research (26). Based on this organization, recurring problems, competitiveness factors, and intervention opportunities were identified by analyzing the consensus reached among participants, allowing the systematization and interpretation of the findings of the participatory diagnosis.

Results and Discussion

Identification of Barriers and Challenges in Artisanal Fishing Communities

The brainstorming sessions revealed the associations' concerns and priorities of those engaged in artisanal fishing. In rural Barrancabermeja, the main problems relate to the lack of government support and the absence of a work plan tailored to fishers' needs and requirements. Table 2 directly reflects the influence of economic factors, as well as human and physical resources, on the growth of the fishing sector within these associations.

Table 2. Brainstorming Results

Dimension	**Issues Identified**
Economic	• Labor informality
Fishing methods (productivity)	• Use of illicit fishing methods • Lack of technology • Lack of infrastructure • High transport costs

doi: 10.25100/iyc.v28i2.15612

Environment	• Lack of control and surveillance • Overexploitation of species (failure to comply with minimum catch sizes) • Sedimentation of the wetlands (Llanito and San Rafael) • Low catch levels
Social	• Lack of social security coverage • Abandonment of the fishing sector • Employment instability • Low education levels

Note: This table compiles the information gathered through the brainstorming sessions on the various barriers and challenges facing the three associations under study.

The first category identified relates to the economic dimension of informality in the fishing sector, which is associated with conditions of vulnerability and affects public health by depriving workers of social security coverage (including pension access) and other legal labor-market benefits (39). This informal employment status nonetheless has significant implications for the purchasing power of fishing families, since low educational attainment and limited formal employment opportunities reflect structural conditions of rural social lag that widen urban–rural disparities in multidimensional poverty. In addition, food insecurity may be driven by insufficient household income which, despite contributing to food production, is not enough to meet food demand (40,41). Consequently, challenges such as informal employment constitute barriers to implementing policies aimed at boosting food production; this reveals a deficit in fishing communities' capacity to adopt strategies against poverty, inadequate food access, and the current employment crisis, which forces many to seek alternative income sources from construction work to jobs with the oil companies that predominate in the region at the expense of fishing traditions.

The second category comprised fishing methods, along with the techniques and tools used to catch fish through artisanal means, an aspect that mirrors the broader trend in Colombia's fishing sector, where the main challenges include the use of illicit fishing methods, particularly destructive practices such as gillnet fishing, locally known as trasmallo (42). These methods not only cause severe damage to aquatic ecosystems but also threaten the sustainability of fish populations through the overexploitation of fishery resources (43). The community also reported that high transport costs, stemming from inadequate infrastructure, limit fishers' access to markets, a situation that often forces them to sell their catch at low prices or turn to informal trade. The scarcity of appropriate technology likewise plays a crucial role, as it prevents fishers from optimizing their capture and processing techniques, hindering the adoption of tools and practices that would strengthen the capture, processing, and marketing of fishery products. By contrast, recent research suggests that implementing sustainable technologies and improving fishing infrastructure are essential to addressing these difficulties (43).

From the members' perspective, weak control and surveillance in the Ciénaga El Llanito and Ciénaga San Rafael de Chucurí wetlands, combined with the overexploitation of species without regard for minimum catch sizes, and wetland sedimentation were identified as major concerns.

doi: 10.25100/iyc.v28i2.15612

This suggests that sedimentation can alter the biological communities of these ecosystems, drive eutrophication, and affect both water quality and environmental health; wastewater discharge and the proximity of oil operations in the corregimiento of El Llanito would further aggravate this situation (44,45). Under these circumstances, these problems show that environmental degradation stems from the interaction between anthropogenic pressures and shortcomings in fishery-resource management and control.

Growing concern over the conservation of key regional fishery resources, such as bagre (catfish), bocachico, and blanquillo, stems in part from fishers themselves, who report a marked decline in fish diversity a finding consistent with Doria-González et al. (46), who note that information on reproduction, genetics, and population structure in the Magdalena River basin remains limited. In contrast, several studies have reported that bocachico, a species that accounts for between 80% and 95% of total catches, has declined by 90% over the past 40 years, a phenomenon attributed to overexploitation, habitat degradation, alteration of river ecosystems, the presence of microplastics, climate change (shifting precipitation and temperature patterns), the use of poorly selective fishing techniques, and the introduction of non-native organisms competing for resources, all of which contribute to the decline of native populations (47,48).

Taken together, these findings suggest that the decline in fish populations constitutes a multidimensional problem that compromises both ecological sustainability and the livelihoods of fishing communities. It is therefore essential for the local economy to strengthen environmental monitoring and surveillance systems and to train community members involved in overseeing fishing activities and protecting aquatic systems. Building alliances between environmental authorities and communities is equally important for identifying illegal practices and promoting the conservation of fish biodiversity.

In the social sphere, several challenges reinforce this condition of vulnerability, including the lack of social protection, employment instability, abandonment of productive activities, and low educational attainment. According to Caldas et al. (5), fishers' educational attainment is considerably constrained by a lack of basic services, low income, the presence of intermediaries, and organizational weaknesses a pattern reflected in national statistics, where the Unsatisfied Basic Needs (UBN) index reaches 65%, classifying this population as vulnerable. Compounding this is a shortage of generational renewal within the organizations, since young people's active participation remains low and many choose to leave the territory in search of employment or educational opportunities, a situation linked to precarious socioeconomic conditions and the limited range of alternatives available to keep young people in these communities.

Prioritization of Barriers and Challenges in Artisanal Fishing Communities

This participatory session used the Regnier Abacus to identify and prioritize the rural communities' problems, as shown in Table 3. This tool engages participants in assessing various factors according to their intensity (cause–consequence relationships), using a color-coding system that facilitates the visualization of priority problems and promotes more equitable participation as a key aspect of effective analysis (32). A matrix was developed recording the number of people who voted

doi: 10.25100/iyc.v28i2.15612

for each issue (frequency) together with color intensity, with the same territorial stakeholders casting the votes, which fosters consensus around the main barriers and challenges to be resolved. Prioritization through the Regnier Abacus optimizes the design of more targeted and effective intervention strategies, grounded in qualitative participatory approaches that promote the joint construction of knowledge in interaction with communities (49). In this case, the results point to the urgency of addressing illicit fishing and sedimentation through environmental control and restoration measures.

It is worth noting that fishers often rely on their daily catch for household consumption as their main source of income, which frequently functions as a subsistence or mitigation strategy for the most disadvantaged communities, particularly those affected by poverty, unemployment, or territorial constraints such as deteriorated tertiary roads, sociopolitical and economic instability, and the impact of armed conflict and forced displacement in rural areas. Beyond these factors lies a still underexplored dimension in the pursuit of small-scale fishing sustainability in Colombia: the organizational strengthening of these communities (50,51). These circumstances indicate that the problems prioritized by the associations stem not solely from productive factors but also from social, territorial, and institutional dynamics that shape the development of fishing communities. Alongside these findings, investment in road infrastructure is needed, together with the promotion of direct marketing of fishery products and the adoption of good resource management and conservation practices. Table 3 presents the results of the Regnier Abacus exercise conducted with the three associations (APALL, ASOPESAMM, and ASOPESCHUCURÍ).

Table 3. Regnier Abacus Results for the APALL, ASOPESAMM, and ASOPESCHUCURÍ Associations

Problem	Association	Frequency	Rating
Wetland sedimentation	APALL, ASOPESAMM, and ASOPESCHUCURÍ	60	
Illicit fishing	APALL, ASOPESAMM, and ASOPESCHUCURÍ	60	
Low productivity	APALL, ASOPESAMM, and ASOPESCHUCURÍ	50	
No market access	ASOPESCHUCURÍ	30	
Poor road conditions	ASOPESCHUCURÍ	30	
Poor fishing practices	APALL, ASOPESAMM, and ASOPESCHUCURÍ	60	
High transport costs	ASOPESCHUCURÍ	30	
Intermediaries	ASOPESCHUCURÍ	30	
No conservation measures	ASOPESCHUCURÍ	30	
Poor waste management	APALL, ASOPESAMM, and ASOPESCHUCURÍ	10	

Note: The prioritized problems emerged from an initial brainstorming workshop (see Table 2)

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Factors for Competitiveness in Artisanal Fishing

To discuss competitiveness factors, it is important to first understand the internal workings of the associations analyzed, which will help optimize their economic activity. Figure 1 shows the activity flowchart identifying the different stages of the production process, facilitating the detection of inefficiencies and the implementation of improvements (33,35).

Figure 1. (A) Graphic representation of the flowchart. (B) Idea-generation session. (C) Photograph of the workshops.

The aspects highlighted in the graphic representation of the flowchart, developed with the participation of members from the three associations evaluated, are presented in detail in Table 3. It highlights the challenges associated with resource overexploitation and poor socioeconomic conditions, factors that hinder the effectiveness of the fishing sector. “This interaction between these problems suggests that the competitiveness of artisanal fishing depends as much on productive capacities as on the organizational and institutional environment and on market access within the territory.” In this regard, fostering mutual collaboration and strategic alliances gives the associations better access to technology, knowledge transfer, and market visibility factors that, according to (52), lead to more favorable outcomes in terms of production and marketing.

doi: 10.25100/iyc.v28i2.15612

Table 4. Competitiveness Factors

Factor	Description	Relationship to the Problem
Technology and Equipment	Tools, vessels, and fishing techniques used in fish capture and processing.	Most participants report the deterioration of vessels and tools, which reduces efficiency, productivity, and income (13).
Knowledge and Training	Technical training and traditional fishing knowledge.	All participants expressed interest in training on modern fishing practices, given the limited information available on resource conservation and environmental management a gap that leads to inefficient methods harmful to the wetlands (42).
Marketing Infrastructure	Market access, transport, and adequate storage for fishery products.	There is clear concern over the lack of market access and continued reliance on intermediaries, given the absence of infrastructure for direct sales, compounded by poor road conditions that deter buyers from reaching the communities and ultimately affect the local economy (15).
Regulation and Public Policy	Regulations governing fishing and government support for artisanal fishing.	More than 50% of participants perceive an absence of clear fishing regulations and policies, a situation that favors overexploitation and ecosystem degradation. This outlook is further worsened by the lack of value-added infrastructure and limited subsidy support (29).
Community Cooperation and Organization	Level of organization and cooperation among fishers, including cooperatives and associations.	The lack of a solid organizational structure limits fishers' ability to negotiate prices and sale conditions, creating dependence on intermediaries. It also hinders access to resources and training programs that would improve fishing practices and resource management (53).
Access to Financing	Availability of credit and financing for investment in production improvements.	90% of association members report limited access to financing sources, which affects their ability to invest in technological upgrades, vessel maintenance, and the acquisition of adequate equipment; this constraint compromises the sector's productive strengthening and, likewise, prevents the diversification of economic activities (54).
Access to Fishery Resources	Availability of and access to aquatic resources, including fish quantity and quality.	Most fishers struggle to obtain sufficient catches, a situation that affects their income and their families' ability to meet basic needs (11), leaving them caught in a cycle of poverty and vulnerability linked to declining fishery resources and the scarcity of alternative economic options.

Note: Data related to the problems were obtained from the Regnier Abacus exercise; competitiveness factors are listed in order of preference as proposed by the members of the fishing associations.

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Community Strategies for Artisanal Fishing

When conducting a participatory rural appraisal, it is essential that participants feel included and that their opinions are valued. The plenary session, as a participatory tool, fosters collective ownership of the proposed strategies. In rural settings, where inequality gaps tend to be wider, the plenary session helps empower fishers and value their knowledge and experience, thereby encouraging the participation of all community members, including women and young people, who often face greater difficulty making their voices heard (36). The plenary session creates a space for intercultural dialogue in which the diverse worldviews and traditional knowledge of rural communities are respected and valued (37). Recognizing and integrating this knowledge with technical and scientific approaches generates a synergy that enriches the strategy-formulation process and helps ensure that the proposed solutions are culturally relevant and sustainable over time.

Even so, the study's findings point to a persistent, significant gap between government, academia, and the private sector one that could hinder the implementation and coordination of the strategies proposed for strengthening the artisanal fishing sector. Weak associativity among fishers is a further obstacle, as it hampers the creation of support networks and the implementation of joint projects (48). Strengthening organization and promoting collaboration among the different stakeholders can improve both competitiveness and communities' quality of life. For these strategies to be effective, therefore, it is necessary to create spaces for dialogue and promote strategic alliances, which can be key to closing this gap and ensuring that fishers' needs and realities are taken into account in policy and program design (13).

doi: 10.25100/iyc.v28i2.15612

Table 5. Community Strategies

Strategy	Description
Strengthening business and technical skills in the fishing sector	These programs should build skills in business management, market access, fish processing, and the adoption of sustainable technologies. Training should be tailored to the local context and should involve fishers in its design and implementation. It also requires community-level organizational strengthening to enable engagement with institutions and access to support services (55). With technical, business, and organizational capacities in place, communities will be better positioned to improve productivity, diversify income, and participate equitably in fishery value chains.
Designing programs for productive diversification	Fishers' economic diversification spans aquaculture, agriculture, ecotourism, and the production of fishery by-products. These findings align with (56), which shows that this strategy generates decent jobs, improves working conditions, and promotes balanced, long-term sustainable economic development.
Establishing direct marketing channels and access to specific markets	Business networks can improve the efficiency of production and marketing, translating into better economic outcomes (19). These networks can also streamline knowledge transfer and innovation, supporting the adoption of sustainable practices and reduced costs (57). Direct market access likewise offers fishers larger profit margins: by bypassing intermediaries, they increase both their income and their economic stability.
Innovation and technology	Promoting technology transfer is vital for rural entrepreneurship. By improving access to innovative practices and financial resources, fishers can enhance their market competitiveness and operational efficiency (58).
Sustainable resource management	Implementing selective, sustainable fishing practices, observing minimum catch sizes and closed seasons, and controlling fishing effort all help secure the future availability of the resource (56). Sustainable management requires awareness-raising, training, and organization, integrating regulation, education, and community cooperation to strengthen the sustainability of the fishery.
Strategic alliances for collaborative development	Ortega Salas (52) shows that strengthening fishers' organizations, combined with technical and business training, would drive the development of fair marketing channels. This process should be complemented by government action that provides a favorable regulatory framework and supports fisheries-management initiatives, while academia contributes by generating locally adapted knowledge to drive innovation.

Note: These strategies were developed during the plenary sessions based on the problems previously identified and prioritized by the fishing associations, through a process of consensus-building and community participation.

Source: Prepared by the authors.

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Conclusions

The participatory rural appraisal conducted in the fishing communities of the Barrancabermeja district identified critical, multidimensional problems, including labor informality, reliance on illicit fishing methods, infrastructure shortfalls, ecosystem sedimentation, a lack of government support, and inadequate social protection all of which compromise the socioeconomic and environmental sustainability of this rural activity. Prioritizing these challenges, facilitated by tools such as the Regnier Abacus, which support the visualization of adverse conditions according to their intensity, made it possible to build consensus around the priority barriers affecting the development of fishing communities. These include the need to strengthen organizational capacities, adopt sustainable technologies, and foster synergies among territorial, public, private, and academic stakeholders in order to develop strategies within a collaborative framework that promotes the community's active participation in the search for solutions.

The findings from the participatory workshops conducted in the fishing communities show that the competitiveness of artisanal fishing is intrinsically linked to a range of socioeconomic and environmental factors identified through participatory methodologies such as the activity flowchart and the plenary sessions. Participants highlighted the need to strengthen access to technology, provide training in modern fishing techniques, and develop marketing infrastructure in order to maximize the efficiency and sustainability of fishery production factors that currently constrain the economic viability of artisanal fishers.

The strategic proposals that emerged from the group dynamics reflect the importance communities place on strengthening community organization, diversifying economic activities, and establishing direct marketing channels to address the problems identified within the territory. Finally, this research made it possible to identify a set of participatory strategies that constitute a valuable input for planning and designing future actions aimed at strengthening the artisanal fishing sector.

CrediT authorship contribution statement

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