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Article

# Productivity improvements and sustainable management in the cooperative fishing society barra ciega of centro municipality, Tabasco

# Mejoras en la productividad y gestión sostenible en la sociedad cooperativa pesquera barra ciega del Municipio del Centro, Tabasco

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## Abstract

This article examines opportunities to improve the productivity and sustainability of the Cooperative Fishing Society Barra Ciega, located in Centro Municipality, Tabasco. The study focused on identifying the cooperative's current weaknesses, such as the lack of technological modernization and inefficient financial management. Through interviews with fishermen, historical data analysis, and the implementation of tools such as SWOT analysis and Ishikawa diagrams, the main areas of opportunity were evaluated. The results suggest that the introduction of advanced technologies for fishery management, along with the modernization of equipment, can significantly increase operational efficiency. Furthermore, training in financial management techniques is proposed as an essential tool to ensure the cooperative's economic sustainability. This research offers a series of practical strategies to enhance collaboration among cooperative members and optimize their performance, thereby contributing to the sustainable development of the local community.

| Objectives | Methodology | Contribution |
|---|---|---|
| - Improve the productivity and sustainability of the cooperative. | - Interviews with fishermen. | - Practical strategies for cohesion and collaboration among members. |
| - Identify weaknesses such as lack of technology and financial management. | - SWOT and Ishikawa analysis to identify opportunity areas. | - Proposals for implementing advanced technology. |
| Propose training in financial management to ensure economic sustainability. | - Analysis of historical productivity data. | - Contribution to the sustainable development of the local community. |

**Implementation, Sustainability, Collaboration**

## Resumen

Para mejorar la productividad y la sostenibilidad el estudio se enfocó en identificar las debilidades actuales de la cooperativa, como la falta de modernización tecnológica y la ineficiente gestión financiera. A través de entrevistas a los pescadores, análisis de datos históricos y la implementación de herramientas como el análisis FODA y el diagrama de Ishikawa, se evaluaron las principales áreas de oportunidad. Los resultados sugieren que la introducción de tecnologías avanzadas para la gestión de la pesca, junto con la modernización de equipos, puede incrementar significativamente la eficiencia operativa. Asimismo, se propone la capacitación en técnicas de gestión financiera como una herramienta esencial para asegurar la sostenibilidad económica de la cooperativa. Esta investigación ofrece una serie de estrategias prácticas para mejorar la cohesión entre los miembros de la cooperativa y optimizar su rendimiento, contribuyendo de esta manera al desarrollo sostenible de la comunidad local.

| Objetivos | Metodología | Contribución |
|---|---|---|
| - Mejorar la productividad y sostenibilidad de la cooperativa. | - Entrevistas con pescadores. | - Estrategias prácticas para la cohesión y colaboración entre miembros. |
| - - Identificar debilidades como la falta de tecnología y gestión financiera. | - Análisis FODA e Ishikawa para detectar áreas de oportunidad. | - Propuestas para la implementación de tecnología avanzada. |
| - Proponer capacitación en gestión financiera para asegurar la sostenibilidad económica. | - Análisis de datos históricos de productividad. | - Contribución al desarrollo sostenible de la comunidad local. |

**Implementación, Sostenibilidad, Colaboración**

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## Introduction

The Sociedad Cooperativa Pesquera Barra Ciega, located in the municipality of Centro, Tabasco, plays a key role in the local economy and according to data from the NODESS directory (Instituto Nacional de Economía Social [INAES], n.d.), the sector faces challenges related to lack of technological modernisation, high operating costs and poor financial management, as indicated by Cisneros, (2022). These problems limit their productivity and sustainability, affecting the economic well-being of their members and the community.

This study proposes innovative solutions to strengthen the cooperative's operations through technological modernisation, the implementation of advanced tools and training in financial management. It is proposed that these measures will increase productivity and ensure economic sustainability.

The problem to be solved is low operational performance and limited sustainability due to lack of modern resources and management skills. The central hypothesis is that the incorporation of advanced technology and financial literacy training will increase productivity and improve the sustainability of the cooperative.

The sections of this article are organised as follows:

1. Current Situation: An overview of the cooperative's specific challenges.

2. Methodology: The tools and methods used to identify and analyse areas for improvement.

3. Results: The key findings and their implications for the cooperative's development.

4. Conclusions: Final recommendations for the implementation of the proposed strategies.

## Current Situation

The Sociedad Cooperativa Pesquera Barra Ciega, located in the municipality of Centro, Tabasco, plays a fundamental role in the fishing economy of the region, providing work and livelihoods for many local families. Following the principles of the International Cooperative Alliance (ICA, 2024), the Sociedad Cooperativa Pesquera Barra Ciega stands out for its social cohesion and commitment among members, which constitutes a solid basis for implementing sustainable strategies and strengthening internal collaboration. However, this cooperative faces important challenges that limit its growth and put its long-term sustainability at risk. According to FAO (2024), the guidelines for sustainable fisheries stress the importance of adopting responsible practices that enable local fishing communities, such as the Sociedad Cooperativa Pesquera Barra Ciega, to balance productivity and long-term sustainability. Among the most critical problems is the lack of technological modernisation, a situation that leads to a large part of their operations being carried out using traditional methods, with records and production control still handled manually. This not only reduces the accuracy and efficiency of their activities, but also impedes the implementation of effective strategic planning and makes it difficult to make informed data-driven decisions.

Despite high operating costs, the cooperative has demonstrated resilience by implementing cost-saving measures, such as fuel optimisation strategies. Fuel, for example, is one of the major expenditures in the operating budget and directly affects the profitability of fishing activities. The vessels, mostly old and worn out, require constant maintenance, which further increases costs. This situation limits the cooperative's ability to reinvest in better equipment and modernise its operations, closing the door to opportunities for expansion and growth.

In addition, the cooperative faces difficulties in managing its financial resources. The absence of a formal accounting system and staff trained in financial management contributes to inefficient use of income, and the lack of a documented financial history complicates access to credit or external financing.

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These resources could be used to modernise infrastructure and train members, but the lack of an adequate financial structure limits this possibility. Strengthening indigenous cooperatives (National Institute of Indigenous Peoples, 2024) is crucial for economic development in vulnerable communities.

Despite these challenges, one of the strongest aspects of the cooperative is the social cohesion and collaboration among its members. There is a strong sense of commitment and solidarity that has allowed the cooperative to survive in difficult times, which is an advantage that could facilitate the implementation of structural improvements. However, it is essential to encourage active participation and continuous training that allows members not only to adopt new technologies, but also to improve their skills in administrative management, so that they can face current and future challenges more effectively. It is therefore suggested to address the Sustainable Fisheries Plan Programme in consultation with IMIPAS (Government of Mexico, 2024) that establishes priorities to promote economic sustainability in the region.

## Methodology

The methodology used combined participatory tools and diagnostic techniques to understand the current problems of the Sociedad Cooperativa Pesquera Barra Ciega. Semi-structured interviews were conducted with the fishermen to collect data on daily operations and challenges faced, which allowed for the identification of recurring themes, such as lack of technology and deficiencies in financial management.

These interviews were key to identifying recurring themes and understanding the operational and financial constraints affecting the cooperative from the point of view of those directly involved in the activities.

Complementing the interviews, an analysis of historical data on the cooperative's fishing production was carried out, covering aspects such as catch volume, operating costs, and variations in performance over time.

This review allowed trends and patterns in productivity to be observed, as well as providing a basis for assessing the impact of external factors such as changes in climatic conditions and fluctuations in market prices, as Yu et al. (2024) have pointed out, changes in natural resource management can be critical to ensure sustainable development in vulnerable sectors. The combination of quantitative and qualitative data was crucial to obtain a balanced view of the current situation.

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**Box1**

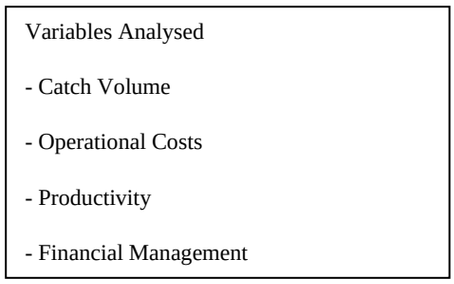


**Figure 1**
Variables analysed
Source: *Interviews conducted*

To structure and deepen the analysis, a SWOT analysis was used, a tool to classify the cooperative's strengths, weaknesses, opportunities and threats, Adesina et al. (2024).

This analysis not only helped to identify internal resources that can be leveraged and obstacles that need to be overcome, but also to examine how external factors, such as lack of access to finance and changes in market demand, impact on the overall performance of the cooperative. In addition, an Ishikawa diagram was applied to decompose and visualise the root causes of the problems of low productivity and high operating costs.

This tool facilitated the identification of complex causal relationships and provided a clear structure for examining how the lack of appropriate technology, high fuel costs and poor financial management interact with each other, affecting the cooperative's operations and sustainability.

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## Box 2

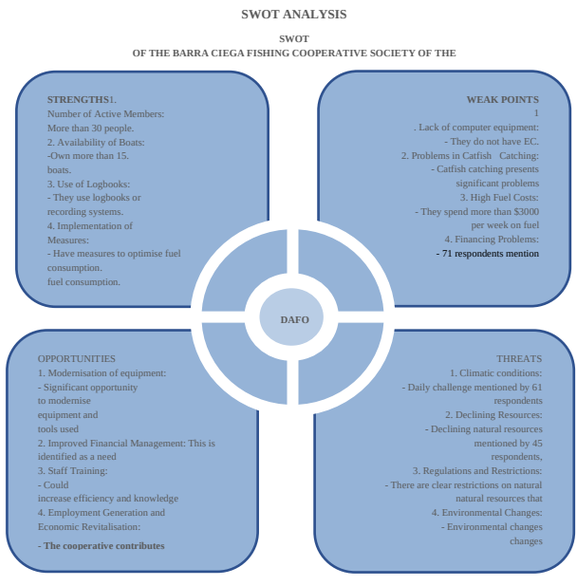


**Figure 2**
SWOT Analysis
Source: *Vidal-Reyes, 2024*

Overall, this methodology allowed not only to assess the current situation of the cooperative, but also to propose practical solutions based on a comprehensive understanding of its challenges and opportunities. The integration of qualitative and quantitative techniques provided a solid and multidimensional perspective, which strengthens the proposed recommendations in terms of their feasibility and effectiveness in improving the cooperative's situation.

## Results

The results of this study revealed critical areas for improvement, especially in productivity, operating costs and financial management. Lack of technological modernisation and reliance on manual methods negatively affect operational performance. In addition, high fuel costs and maintenance of obsolete vessels limit the profitability of fishing activities. In terms of operational costs, fuel expenditure was identified as one of the main economic burdens for cooperative members. This high cost, coupled with the constant need for boat maintenance, affects the profitability of fishing activities. Many of the fishermen pointed out that their vessels are obsolete and that preventive and corrective maintenance has become a recurrent economic burden.

This problem not only reduces the fishermen's net income, but also limits the possibility of reinvestment in more efficient and sustainable equipment.

The assessment of the cooperative's financial management yielded another set of important findings. Currently, the cooperative lacks a formal accounting system and a structured plan for managing its income and expenditures. This lack of organisation in the management of financial resources translates into a significant dependence on inconsistent income and limited savings capacity. In addition, the lack of a documented financial history makes it difficult to access external funding or support that could be used to modernise equipment and optimise the cooperative's operations. This represents a major barrier to the sustainable development of their activities and to the strengthening of their productive capacity in the long term.

These results provide a solid basis for the recommendations proposed in this study. The combination of technological modernisation, cost optimisation and strengthening of financial management are key elements that could transform the functioning of the cooperative and ensure its viability in a competitive and constantly changing environment. The implementation of these improvements would not only benefit the members of the cooperative, but also the local economy at large. Raji et al. (2024) highlight how the integration of technology and market strategies can improve productivity in economic sectors such as agriculture, which is also applicable to the fisheries sector.

## Box 3

| Variable | Result |
|---|---|
| Catch and Productivity | 89 members report catches in excess of 1500 kg weekly. |
| Catfish Harvesting Problems | Catching catfish presents difficulties, affecting the efficiency of the cooperative. |
| Fuel Costs | 93 members spend more than $3000 per week on fuel. |
| Fuel Optimisation | 104 members have implemented fuel saving strategies. |
| Catch Recording | 104 members use logbooks or systems to document catches. |

**Table 1**
Main Results
Source: Vidal-Reyes 2024

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**Box 4**

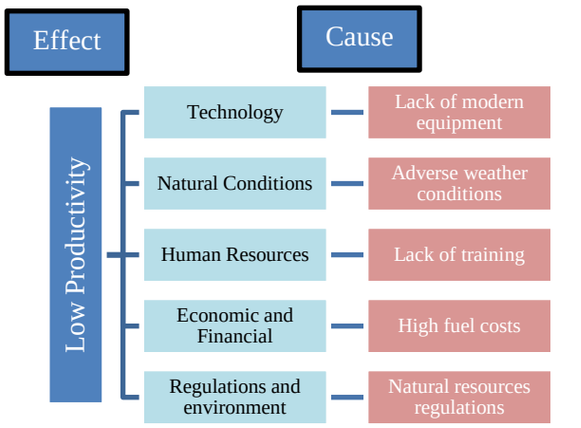


**Figure 3**
Cause effect
Source: *Vidal-Reyes, 2024*

## Conclusions

This study confirms that the Sociedad Cooperativa Pesquera Barra Ciega faces significant challenges that limit its productivity and long-term sustainability. Among the most relevant problems are the lack of technological modernisation, high operating costs and deficiencies in financial management.

Through a comprehensive analysis, including the use of tools such as the Ishikawa diagram and SWOT analysis, key areas were identified in which the cooperative can intervene to improve its performance and viability.

The incorporation of advanced technology emerges as one of the most urgent and effective solutions. The implementation of digital recording systems and technological tools for production management would enable the cooperative not only to improve its operational efficiency, but also to obtain more accurate data for strategic decision-making. This change would reduce reliance on manual methods and optimise control over catches and costs, facilitating more accurate and productive management.

In terms of operational costs, in addition to modernising vessels and providing training in financial management, it is recommended that social cohesion among members be fostered, which will be essential for long-term sustainability.

These changes would not only reduce fuel costs, which represent one of the main financial burdens for cooperative members, but would also contribute to improving the profitability and sustainability of fishing activities. Optimising these resources would allow cooperative members to increase their profit margins and reinvest in better equipment and training.

Financial management is another critical aspect that needs to be strengthened to ensure the sustainability of the cooperative. The creation of a formal accounting system and training in resource management would help members manage their income and expenses more effectively. In addition, a well-documented financial history would increase the likelihood of accessing external funding and other support that could be used to expand the cooperative's capacities and improve infrastructure.

Finally, social cohesion and commitment among members are essential factors for the implementation of these improvements. Encouraging active participation and continuous training would help cooperative members to adopt new technologies and management practices more effectively. This sense of collaboration also facilitates resilience to future challenges and strengthens the role of the cooperative in local economic development.

In conclusion, the combination of these strategies could significantly transform the sustainability of the cooperative, securing its future in a competitive environment. Strategic design is essential to ensure that organisations achieve sustainable productivity, as indicated by Sari and Nugraha (2024). In the case of the fishing cooperative, this involves the implementation of advanced technologies and continuous training, which would maximise operational performance and ensure long-term sustainability. These recommendations will not only benefit the cooperative in terms of economic performance, but also strengthen its impact on the local economy, ensuring its viability in an increasingly competitive and changing environment. Liu et al. (2024) found that sustainable techniques such as organic fertilisation and no-tillage can have a significant impact on productivity, reflecting the potential of the strategies proposed in this study.

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**Annexes**

*Questionnaire applied to Sociedad Cooperativa Pesquera Barra Ciega*

This questionnaire was designed to collect key information on the practices, challenges and needs of the Sociedad Cooperativa Pesquera Barra Ciega. Its main purpose is to identify areas for improvement and opportunities for development that can strengthen the co-operative's operations. The data obtained will serve as the basis for the recommendations and proposals included in this project.

1. How many people currently make up the cooperative and how many of them are directly involved in the fishing activity?

Mark only one oval.
Less than 10
From 10 to 20
20 to 30
More than 30

2. How many boats does the cooperative own for fishing activities?

Mark only one oval.
Less than 5
From 5 to 10
From 10 to 15
More than 15

3. Does the cooperative have computer equipment or other technological devices for record-keeping or analysis related to fishing?

Mark only one oval.
Yes, it has computer equipment
Yes, it has other technological devices
No, it does not have computer equipment or technological devices
Not sure

4. Do you keep detailed records of fishing boat trips?

Mark only one oval.
Yes, they keep detailed records
No, they do not keep detailed records

5. Do you use logbooks or any recording system to document the amount of fish caught on each fishing trip?

Mark only one oval.
Yes, do they use logbooks or other recording system?
No, they do not use a logbook or recording system.

6. What is the average number of kilograms of fish you manage to catch per week as a cooperative?

Mark only one oval.
Less than 500 kg
From 500 kg to 1000 kg
From 1000 kg to 1500 kg
More than 1500 kg

7. Have you faced any problems related to catfish catching in the area where you operate?

Mark only one oval.
Yes, have you faced problems with catfish catching?
No, they have not faced any problems with catfish catching.

8. What impact does this problem have on the productivity and profitability of the cooperative?

Mark only one oval.
Low impact
Moderate impact
High impact
Not sure

9. What are the costs associated with the purchase of gasoline for vessels used in fishing?

Check one oval only.
Less than $1000 per week
From $1000 to $2000 per week
From $2000 to $3000 per week
More than $3000 per week

10. How have you managed these costs and looked for ways to optimise fuel consumption?

Check only one oval.
Implementing optimisation measures
Have not implemented optimisation measures

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11. How long have you been involved in fishing within the cooperative?

Mark only one oval.
Less than 1 year
1 to 5 years
5 to 10 years
More than 10 years

12. What is your function or role within the cooperative?

Mark only one oval.
Fisherman
Fish processing
Marketing
Other:

13. What fishing techniques or methods do you usually use?

Mark only one oval.
Trawls
Hook and line fishing
Traps or pots
Other:

14. What kind of equipment and tools are necessary to carry out your fishing activity?

Mark only one oval.
Nets
Hooks and lines
Boats
Other:

15. Have you noticed any changes in fishing methods in recent years? What changes have you observed?

Mark only one oval.
Yes, significant changes
Yes, minor changes
No, I have not noticed any changes

16. What natural resources do you use for fishing in this area?

Mark only one oval.
Fish
Crustaceans
Molluscs
Other:

17. How would you describe the quality and quantity of the resources available in the fishing area?

Mark only one oval.
Good quality and quantity
Acceptable quality, but limited
limited
Poor quality and quantity

18. Are there any restrictions or regulations on the natural resources that can be used for fishing?

Mark only one oval.
Yes, clear restrictions
Some restrictions
No restrictions

19. What are the main challenges you face in your daily fishing activity?

Mark only one oval.
Climatic conditions
Decreasing resources
Competition with other cooperatives
Other:

20. What factors do you consider limit productivity in the cooperative?

Tick only one oval.
Lack of modern equipment
Financing problems
Shortage of skilled labour.
Other:

21. Have you experienced changes in the environment that have affected fishing in the area?

Mark only one oval.
Yes, significant changes
Yes, minor changes
No, I have not experienced any changes

22. How would you describe the dynamics and the relationship between the members of the cooperative?

Tick only one oval.
Collaborative and supportive
Competitive
Dysfunctional

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23. What actions are carried out to

promote collaboration and solidarity among the members of the cooperative?
Tick only one oval.
Regular meetings
Team trainings
Incentive programmes
Other:

24. From your point of view, what aspects could be improved to increase productivity and well-being within the cooperative?

Tick only one oval.
Modernisation of equipment
Improvement of financial management
Staff training
Other:

25. How do you think the cooperative contributes to the socio-economic development of the local community?

Tick only one oval.
Employment generation
Economic dynamisation
Improvement in the quality of life of the inhabitants

## Box5

| No. | Question | Most frequent response | Porcentage |
|---|---|---|---|
| 1 | How many people are currently members of the cooperative and how many of them are directly involved in the fishing activity? | more than 30 | 91 |
| 2 | How many boats does the cooperative own to carry out fishing activities? | more than 15 | 91 |
| 3 | Does the cooperative have computer equipment or other technological devices for record keeping or analysis related to fishing? | No, they do not have equipment | 64 |
| 4 | Do they keep detailed records of fishing boat trips? | Si | 50 |
| 5 | Do you use logbooks or any recording system to document the amount of fish caught on each trip? | si | 91 |
| 6 | What is the average number of kilograms of | Over 1500 kg | 73 |
| 7 | of fish that you manage to catch each week as a cooperative? | Yes | 91 |
| 8 | Have you faced any problems related to the catfish catch in the area where you operate? | High impact | 64 |
| 9 | What impact does this have on the productivity and profitability of the cooperative? | More than 3000 per week | 82 |
| 10 | What are the costs associated with the purchase of gasoline for the boats used in the fishery? | Implement optimisation measures | 95 |
| 11 | How have you managed these costs and sought ways to optimise fuel consumption? | more than 10 years | 63 |
| 12 | How long have you been involved in fishing within the cooperative? | fisherman | 67 |
| 13 | What is your function or role within the cooperative? | traps or pots | 87 |
| 14 | What fishing techniques or methods do you usually use? | boats and hooks | 47 |
| 15 | What kind of equipment and tools are necessary to carry out your activity? | yes | 91 |
| 16 | Have you noticed any changes in fishing methods over the last few years? What changes have you observed? | fish | 96 |
| 17 | What natural resources do you use for fishing in this area? | acceptable quality | 63 |
| 18 | How would you describe the quality and quantity of the resources available in the fishing area? | clear restrictions | 86 |
| 19 | Are there any restrictions or regulations on the natural resources that can be used for fishing? | climatic conditions and diminishing resources | 87 |
| 20 | What are the main challenges? | funding problems | 65 |
| 21 | What factors do you consider limit productivity in the cooperative? | yes | 94 |
| 22 | Have you experienced changes in the environment that have affected fishing in the area? | collaborative and supportive | 96 |
| 23 | How would you describe the dynamics and relationship between the members of the cooperative? | regular meetings | 76 |
| 24 | What actions are taken to | modernisation of equipment | 40 |
| 25 | From your point of view, what aspects could be improved to increase productivity and well-being within the cooperative? | employment generation | 64 |

**Table 2**
Survey summary results
Source: Vidal-Reyes 2024

## Statements

## Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this paper.

## Authors' contributions

*Vidal-Reyes, Laura*: Contributed the project idea and research development.

*Javier Geronimo, Zinath*: Contributed research development and data analysis.

*Reyes-Osorio, Yaitla Aitzac:* Contributor to the revision and editing of the manuscript.

*Rivera Rodríguez, María*: Contributed to the research method and data analysis.

## Availability of data and materials

Data sets used or analysed during this study are available from the corresponding author upon reasonable request.

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## Abbreviations

| | |
|---|---|
| FODA | Strengths, Opportunities, Weaknesses and Threats |
| PIB | Gross Domestic Product |
| IMIPAS | Mexican Institute for Research on Sustainable Fisheries and Aquaculture (Instituto Mexicano de Investigación de Pesca y Acuacultura Sustentables) |
| NODESS | Nodes for the Promotion of the Social and Solidarity Economy |
| INAES | National Institute of Social Economy |

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