

Artisanal Fishing Score: A New Certification Method for Small-scale Fisheries

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Abstract

Small-scale fisheries can guarantee enough supply of fish production around the world with low expenditure of energy, although they operate through some constraints. Certification schemes have been printing the sustainability face in fish products, some aspects like transparency, traceability and standardization catches international suppliers attention for those products, and the communication with consumers are one of the benefits ecolabels can bring to firms. With lack of data, huge costs, and low infrastructure, certification schemes become hard to reach for small-scale fisheries, leaving the sustainability face only to large scale firms. Due to a large portion of global artisanal fishing does not reaching the so-called sustainable market because certifications are unattainable for artisanal fishermen and women, the current paper searched on developing a new certification method that corresponds to the scenario and demands of artisanal fishing, the proposed method is based on the validation of the artisanal fisherman, distinguishing them from the industrial fishing activity. Four dimensions of analysis were proposed: Operational, Boat, Crew and Nature of Activity. From the analysis of each dimension, the fishery can be classified as Industrial, Transitional Industrial, Transitional Small-Scale and Small Scale. We performed the Artisanal Fishing Score (AFS) on a artisanal fishing community and they were categorized as small-scale by the method. We could infer that this is a trustable method to be implemented in certification process to improve communication between consumers and artisanal fish producers.

1. INTRODUCTION

Fisheries value chains are described by De Silva (2011) as a high-level method to create competitive advantage in the market, in which fishery actors add processes into raw materials to sell a more complex product to consumers. The value chain can also be divided into value addition and value creation, the first occurs when, for example, the raw material passes through any processor method to become a more finished product, and the second, that will be more discussed in this study, is shown when the product is characterized by any differentiating method to increment value in marketplace (Bjorndal et al., 2014).

The consumer's willingness to pay (WTP) for sustainable products is shown by Li and Kallas (2021) as a great market potential for any food sector worldwide, and an increasing trend. In European markets, Zander and Feucht (2018) demonstrated that consumers look at local and domestic seafood productions with preference against exported fish. Hilger et al. (2019) also corroborates with the theory that consumers have preferences for sustainable seafood products, they argued that selective gear, wild-caught fish and local production are aspects consumers look at when purchasing a product.

Small-scale fisheries (SSF) have different characteristics around the world, although in the field of production, there is unanimity that the main goal is to furnish a sustainable and steady stream of aquatic resources for generations (Berkes et al, 2001). Even though small-scale fisheries operate through some constraints, they can guarantee enough supply of fish production around the world with low expenditure of energy (Pauly, 2006).

Some sustainable characteristics guide the artisanal fisheries *modus operandi*, such as the characteristics of the gear types, boat size and type, depth of fisheries, number of crew, use of engine, engine size, among other (Chuenpadgee et al., 2006). Besides, small-scale fisheries anchor local communities social relations such as values, traditions, and other structures. They also has an important relation with land, due to the dependence of the activity on healthy ecosystems and the need of access tenure rights to land (FAO, 2015). But how can consumers differentiate SSF products from Industrial fisheries? Based on this question, this research sought to answer, which criteria the fishery activity and actors should be embedded to be considered artisanal.

To justify the importance of this research, a certification scheme was designed to improve the relationship between consumers and artisanal fish producers, envisioning the scenario that ecolabels can help concerned consumers in their decision making process, ensuring that the product purchased is from sustainably source (Ramachandran & Parappurathu, 2020; Haas et al., 2020).

As discussed by Lazaroiu et al. (2019), environmentally concerned consumers are often purchasing labeled organic products due to quality and confidence presented in some labels being the key factors which consumers decide for a product. On the other hand, ecolabeled fish product presents a deficit trust in consumers when compared to organic farming, due to the difficulty in fish consumers to verify whether fish producers are following all the certification standards (Ramachandran & Parappurathu, 2020).

Certification schemes have been printing the sustainability face in fish products, some aspects like transparency, traceability and standardization catches international suppliers attention for those products, and the communication with consumers are one of the benefits ecolabels can bring to firms (Washington & Ababouch, 2011; Long & Jones, 2021). However, Small-scale fisheries face a different scenario, with lack of data, huge costs, and low infrastructure, certification schemes become hard to reach, specially those from developing countries, leaving the sustainability face only to large scale firms (Nyirawung et al., 2022; Blasiak et al., 2017).

In this context, this study aims to develop a new scalable certification method focused on small-scale fisheries demands. According to the systematic review of literature on fisheries certification from de Melo, et al. (2024), results presented that certifications and ecolabels most used today make artisanal fishing products invisible on sustainable markets, due to various barriers such as costs and lack of data in achieving and maintaining certification criteria.

Due to a large portion of global artisanal fishing does not reaching the so-called sustainable market because certifications are unattainable for artisanal fishermen and women, the current paper searched on developing a new method to distinguish small-scale fisheries that corresponds to the scenario and demands of the activity, the proposed method is based on the validation of the artisanal fisher, distinguishing him from the industrial fishing activity.

2. THE ARTISANAL FISHING SCORE

In this section, the Artisanal Fishing Score (AFS) method for small-scale fisheries certification will be presented. It is based on the distinction between industrial and artisanal fisheries. The operational and identity aspects that embed fishing activities are explored to assure that the fish comes from traditional fishing communities.

The development of the method was analyzed in three stages, the first consisted of a Document Analysis to identify the main characteristics and definitions of Artisanal Fishing to extract the variables, through a Literature Review in the Scopus and Web of Science databases. The second stage used the qualitative method for interviews with Artisanal Fishing experts and fishers from the selected communities. The objective was to understand in depth the content of the reports (Richardson, 2017), which presented aspects of the nature of the Artisanal Fishing activity. The third moment included a quantitative approach to analyze the variables raised in the Literature Review and explored in interviews with fisher men and women, the use of the additive model in data processing was used to analyze the relationships between the variables (Richardson, 2017) and defining the profile of Artisanal Fishing.

2.1 Data Collection

To validate the information collected in step two and to better understand which would be the best locations to visit, two experts were interviewed, the representative of the Fisher's Pastoral Commission and a researcher from the Artisanal Fishing area of the Joaquim Nabuco Foundation.

Data collection was implemented in the first two stages of the study, the first being the Document Analysis that allowed listing the Artisanal Fishing Parameters, while the second consisted of interviews with Specialists and Artisanal Fishers during on-site visits.

Structured interviews were carried out with Artisanal Fisheries experts in Pernambuco. The purpose of the interviews was to identify the main problems faced by the communities, in order to understand whether a new certification method helps in resolving some of the reported impediments, in addition to mapping the fishing communities with the greatest relevance in the state in relation to their production and commercialization, and which had a fishing colony, infrastructure and political articulation.

All interviews were conducted by the first author and carried out in person and remotely. The interviews content questions are available on Appendix A. The on-site visits were made to one location in the state of Pernambuco. The questions that were asked of the fishermen and women are specified in Table 1. To carry out the interviews, the project was approved by the Ethics Committee. All interviews were carried out with consent by everyone involved. The communities were carefully selected so that the interviewees had no type of relationship with the interviewer, to reduce potential sources of bias.

2.2 Data Input

The method uses data inputs, from fisher's interviews. The interviews capture variables from boat, fishery and nature of characteristics based on a literature review on Chuenpadgee et al. (2006), Smith and Basurto (2019), Noman et al. (2019) and Food and Agriculture Organization (FAO) documents that presented not only characteristics of the activity, but also provided parameters that could portray artisanal fishing.

With the findings, it was possible to list the necessary variables and parameters for each of them. Table 1 presents the variables analyzed to define the activity, the questions addressed to the fisher interviewed, as well as the parameters used, based on the bibliographic review.

Table 1
Variables defining small-scale fisheries

Variables	Question	Small-Scale Fisheries Parameters	References
Gear type	What are the fishing gears used?	coastal gathering, fishing on foot, beach seine, small ring net, handline, dive, traps	Smith and basurto, 2019 ; Chuenpadgee et al., 2006
Number of crew	How many fishers participate the expeditions?	2–3; 5–6	Chuenpadgee et al., 2006
Boat Type	What type of boat?	canoe, dinghy, non-motorized boat, wooden boat, boat with no deck, traditional boat	Chuenpadgee et al., 2006
Boat GRT	How much kg of fish does the boat supports?	less than 10 GRT (3 to 50 GRT)	Chuenpadgee et al., 2006
Boat Size	What is the boat size?	between 5-7m; less than 10, 12 or 15m (2 to 24m)	Chuenpadgee et al., 2006; Noman et al. 2019
Size Engine	What is the size of your boat engine?	less than 60 HP; between 40–75 HP (15 to 400 HP); However, 25% defined SSF as boats with outboard engines of 100 hp or less, with few SSF characterized as vessels with inboard motors	Smith and basurto, 2019 ; Chuenpadgee et al., 2006
Distance from shore	How distant is the fishery from the shore?	between 5–9 km; within 13 km; upto 22 km	Chuenpadgee et al., 2006
Water depth	How deep is the fishery?	less than 10, 50 or 100m depth	Chuenpadgee et al., 2006
Travel time	How many hours do you spend fishing by the day?	2–3 hours from landing sites	Chuenpadgee et al., 2006
Nature of Activity	What is the nature of the activity?	subsistence, ethnic group, traditional, local, artisanal	Chuenpadgee et al., 2006
Source: Authors (2024)			

The aim of the method is to certify fish from artisanal fishing, but without modifying its structure and has the purpose of strengthening the activity by seeking to bring the producer closer to the consumer, making its production chain cleaner and the quality and value of the product being intrinsic. Therefore, it is necessary to differentiate the artisanal product from that which comes from a large scale, since, based on a systematic literature review on fisheries

certifications and ecolabels by the authors, there is no record of this distinction on the market currently. With this method we aim to make it easier for consumers who seek to consume artisanal products to make assertive choices and strengthen artisanal fishing activities.

2.3 Analysis

To analyze the variables described on Table 1, the variables were divided into 4 dimensions. Table 2 shows the dimensions matched to each variable of analysis.

Table 2 Dimensions of Analysis.	
Dimension	Variable
<i>D</i> ₁ —Operational	Gear type
	Distance from shore
	Water depth
	Travel time
<i>D</i> ₂ —Boat	Boat
	Boat Type
	Boat GRT
	Boat Size
	Engine
	Size Engine
<i>D</i> ₃ —Crew	Number of crew
<i>D</i> ₄ —Nature of Activity	Nature of Activity

Source: Authors (2024).

The variables listed on Table 2 were computed using the additive model, which is divided into two stages. The first stage indicates intradimensional aggregation and the second stage all results of each dimension are computed using an equal weight.

To the first stage, the following model computed the results of the each variable, using an equal weight $\frac{1}{n}$ to each four dimensions (*D*₁ Operational, *D*₂- Boat,*D*₃- Crew and *D*₄- Nature of activity).

$$d_n = \sum_{i=1}^n q_i \frac{1}{w_i}$$

[1]

Where:

$$d_n$$

Score of dimensions *n*,

$$q_i$$

Result of the assessment of question *i* of dimension *n*, and

$$w_i$$

Weight of of question *i* of dimension *n*.

In the second stage, the equation below was used to compute equal weights to all four dimensions. The result represents the Artisanal Fishery Score (*AFs*), demonstrating how close or far, the fisher characteristics are from the perfect small-scale fisheries scenario. The results of each dimension (*d_q*) were computed using equal weights.

$$AFs = \sum_{q=1}^n d_q (0.25)$$

[2]

As SSF has different characteristics around the world, we created a scale of propensity, based on each dimension parameter. The results range from 0 to 1, where 0 represents a strong distance from the Small-Scale Fishery parameters and 1 shows a high propensity of SSF activity on the sample. The Table 3 presents the scores categorized in 4 classifications (Industrial Fishing, Transitional Industrial Fishing, Transitional Small-Scale Fishing and Small-Scale Fishing).

Table 3
Categories of Artisanal Fishing Score

Score	Label	Description
$0 < AFscore \leq 0.25$	Industrial Fishing	Total absence of small-scale fishing characteristics.
$0.25 < AFscore \leq 0.5$	Transitional Industrial Fishing	At least one characteristic of small-scale fishing was present.
$0.5 < AFscore \leq 0.75$	Transitional Small-Scale Fishing	More than one small-scale fishing characteristic was identified.
$0.75 < AFscore \leq 1$	Small-Scale Fishing	Several or all small-scale fishing characteristics were identified.

This method helps identifying how close fishers are from the appropriate small scale fishing scenario. This is a convenient method because do not deal with linear scale, choosing if the fisher is or is not artisanal, but it generates scales of propensity which helps to generate a more trustworthy score to infer that the producer comes from traditional communities.

3. NUMERICAL APPLICATION

To demonstrate the Artisanal Fishing Score operation, an application was made in one artisanal fishing community. According to the selection criteria raised (production, community organization and available infrastructure), the selected community were Rio Formoso due to their positive articulation with academic research and among the community through colonies and organizations, in addition to constancy in production and flow.

We performed structured interviews (Cooper & Schindler, 2016), following a detailed guide of questions related to the variables raised in the documentary analysis, which identified the main characteristics of the profile of artisanal fishermen and women (Table 1).

Data collection in the communities was carried out in June, the sample size was 9 people interviewed, as it is an exploratory study, where there is still not much knowledge about the topic, and this is constructed based on the information provided by the subjects (Creswell, 2007), the quantitative worked, it would not necessarily need to be high, as the content of the reports matters more for the research.

3.1 Rio Formoso

The municipality of Rio Formoso is located in the state of Pernambuco, in Mata Sul, 88km from the capital. According to IBGE (2022), the population has 20,009 inhabitants, with a Human Development Index of 0.613 and GDP per capita of R\$16,015.49. Known as the land of mangroves, Rio Formoso has a close relationship with Artisanal Fishing, fishermen make fishing traps, boats and the shellfishing activity carried out by women stands out in the region (Tapioca, 2020).

Based on the 9 respondents, we performed the Artisanal Fishing Score to each dimension and the overall score. Only the fishery dimension and the nature of activity dimension scored a Transitional Small-Scale Fishing characteristics. The other dimensions, including the overall Artisanal Fishing Score, reached the Small-Scale Fishing level.

Table 4
Rio Formoso results

Dimension	Score	Label
D_1	0.69	Transitional Small-Scale Fishing
D_2	0.80	Small-Scale Fishing
D_3	0.91	Small-Scale Fishing
D_4	0.66	Transitional Small-Scale Fishing
AF_{Score}	0.77	Small-Scale Fishing

The results, presented in Table 4 above, suggest that the fishers interviewed on Rio Formoso can be considered artisanal as the fishery scored 0.77 in overall dimensions. Even though there are some constraints that we should consider, the dimension D_1 reached a score that locates the fishery in a Transitional

Small-Scale Fishing level, in which, any of the variables analyzed in this dimension like gear type, fishing location, depth, and travel time is distancing from what is considered artisanal.

The same is observed on D_4 , when the nature of the activity is analyzed. These results reflect the method used, the additive model compensates the dimensions, and the less weighted vertex is compensated in the most heavies.

The dimensions D_1 - Operational and D_4 - Nature of Activity being located in a transitional small-scale fishing level, lights up an alert to the community, to understand if the fishery is becoming uncharacterized. The method can also be used as a monitoring tool, to assess the fishery through time.

A graphical representation of the results is presented in Fig. 1. The disposal of the dimension was selected especially to highlight the AF_{Score} at the top of the vertex.

4. CONCLUSION

The Artisanal Fishing Score (AF_{Score}) is a new method developed to identify whether the fishing community can be certified as Small-Scale. The method was developed based on three stages, the first was a bibliographic review to identify studies that list definitions of small-scale fisheries. Then we performed some interviews with experts and artisanal fisheries to better understand the fishing communities' characteristics and the third stage was the development of the method.

The method consisted of an additive model that divided the fishing characteristics into four dimensions, according to the operational, boat, crew and nature of activity characteristics. Then we compile the results of each dimension into the overall score, which we call the Artisanal Fishing Score. The AF_{Score} classify the results into four categories, industrial fishing, transitional industrial fishing, transitional small-scale fishing and small-scale fishing.

We performed the model in a community indicated by the experts as a real artisanal fishing community, and the results indicated that they were categorized in the small-scale fishing level, leading us to infer that the method can be used to identify small-scale fishing communities.

Through the application of AF_{Score} on Rio Formoso's community, the model analyzed four dimensions of fishers. The D_1 - Operational and D_4 - Nature of Activity positioned the fishery into a Transitional Small-Scale Fishing level, which corresponds that the fishery is turning to Small-Scale or is distancing from this scenario.

If an evaluation is made annually to the fishery, we can analyze if they are getting closer or far from SSF characteristics. In addition to being a certification model, the AF_{Score} can also be used as a monitoring tool.

As a compensatory model, the Artisanal Fishing Score generates ponderation to the dimensions, with a sensibility analysis performed, robustness would be added to the certification tool. With a sensibility analysis we can investigate the tolerance of the labels change.

We recommend that future works include an industrial fishing scenario to compare if the method works on the other side of the activity. In addition, using different weights in each dimension can be tested in other works to test the difference between the analyses and a sensibility analyze should be performed.

Furthermore, we conclude that this new method can be included in a certification process to raise the communication between consumers and fishing producers, especially those who seek for sustainable fishing products.

Declarations

Ethical Approval The research was approved by the Human Research Ethics Committee standard from the Federal Rural University of Pernambuco (CEP/UFRPE). The CEP/UFRPE follow the guidelines of the Brazilian National Health Council of the Ministry of Health (CNS/MS) and the National Research Ethics Committee (CONEP). (Ethical Approval Number: 6.787.165) All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Human Ethics and Consent for publication Not Applicable.

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Availability of data and materials The datasets generated and/or analyzed during the current study are not publicly available due to the privacy and confidentiality of the interview participants, but are available from the corresponding author on reasonable request.

Competing Interests The authors declare that they have no competing interests.

Authors' contributions M.M. wrote the main manuscript text, conducted the field interviews, analyzed the data, and discussed the findings. M.S. contributed to the development of the model and the application of the statistical method. A.R. assisted in structuring the interviews, secured the ethics committee approval, and performed the general review. All authors reviewed the manuscript.

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Figures

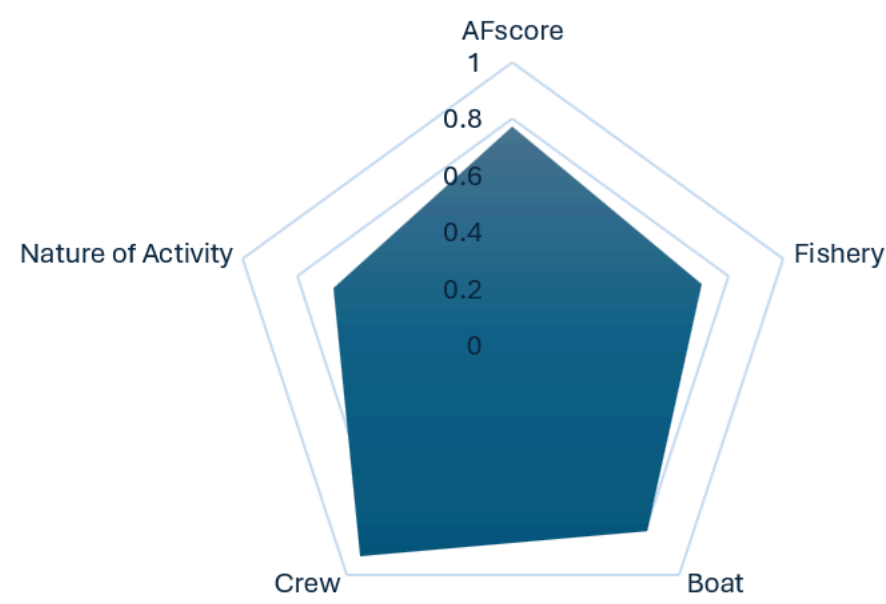


Figure 1
Rio Formoso radar results

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