

Small Scale Fish Processing Can Increase Consumption and Fishery-Based Economies in Africa and Latin America: Systematic Review

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Abstract— Fishery's economy is related to industrial efforts and public policies in aquaculture, fishing and food chain. Low- and medium-income countries in both Africa and Latin America evidences long coasts, important fresh water resources and aquaculture although commerce does not follow the tendency of natural and intensive or extensive aquaculture resources. This paper aims to review systematically articles and instructions or manuals from 1990 to 2023 according to PRISMA statement within keywords “small scale fishery”, “minced fish”, “grinded fish”, “manual grinder” and “value added species” combined differently, maintaining the last one as a constant. Collateral, packing was investigated, if any publication lead to a viable option for small markets, fairs and informal sellers. Due to little evidence, manuals are publication option to undertake scene of value-added species through small scale processing, specially grinding and grouping by similar sensorial characteristics. It is mandatory further discussion within experimental studies in order to evidence how to amplify food safety and security not dissociated of economic development of fishery.

Index Terms—Small scale fishery, food processing, value added species.

1. Introduction

This review paper analyses the challenges faced by traditional fisheries in Africa and Latin America, particularly in Senegal and Brazil, amidst the rise of industrial fishing and globalization.

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While historical scenarios from developed nations like Japan and Canada highlight the potential of factory ships and new technologies to access wider markets (e.g., through tuna cans, non-native species, and ready-to-cook fillets) (Akiba, 2023; Hutchings & Myers, 2019), these approaches might not be directly applicable to the smaller-scale, artisanal nature of fisheries in developing countries.

Traditional fishing communities in Senegal, like those in Kayar and Joal, often lack the infrastructure and resources to compete with the heavy machinery and large-scale operations of industrial fishing (Camara, 2011). This, coupled with the influx of globally sourced and readily available fish species, presents a significant challenge to their survival and ability to meet local market demands and food security needs (Camara, 2011; World Bank, 2018).

Similarly, in other African and Latin American countries, including Brazil, artisanal fishers often struggle to compete with industrial fishing and large-scale aquaculture operations due to limited access to technology and market infrastructure (Jentoft et al., 2017). This further exacerbates issues of food insecurity and post-harvest losses due to perishability (FAO, 2018).

While developed nations like Japan, Canada, and Norway established efficient national supply chains through industrial fishing (Akiba, 2023; Hutchings & Myers, 2019), their lack of investment in building and strengthening local markets in African and Latin American economies proved detrimental (Charles, 2012). The absence of context-specific technological innovation further marginalized local fisheries (Charles, 2012). As economist Maria da Conceição Tavares (2019) argues,

"In the former (the case of central economies), although exports were an important dynamic element for the formation

of national income, without which its expansion cannot be explained, they were not solely responsible for economic growth. In reality, this exogenous variable was coupled with a highly relevant endogenous variable, namely, autonomous investment accompanied by technological innovations" (Tavares, 2019, p. 62).

Therefore, understanding the state of the art and techniques employed by small-scale fisheries in Africa and Latin America, with a specific focus on Brazil, becomes crucial. This study aims to explore value-added processing techniques as a potential mechanism for these communities to adapt and survive. These techniques, such as processing traditional products like "boulettes" and "farci" (meatballs) or exploring new methods for extending shelf life, could help these communities navigate the challenges of competition and food security while upholding their traditions (Aasha et al., 2014; Menezes et al., 2010).

2. Systematic Review: Material And Methods

It was performed a systematic review according to PRISMA statement, inputting "value added species" followed by "small scale fishery", "minced fish", "grinded fish", "manual grinder" in different arrangements on Web of Science's and Food and Agriculture (FAO)'s repositories.

Nineteen publications were found in initial search without any filters other than year range (1990 – 2023) and keywords. We proceeded to duplicate and thematical pertinence filters. Twelve papers were selected in final filter.

Inclusion criteria, necessarily, restricted output to peer-reviewed research articles, reports, and case studies, focus on SSFs in Africa, Latin America, or specifically Brazil, and one which addressed value-added processing techniques and their impact on market access, particularly fairs and informal markets. Data criteria kept the ones published between 1990 and 2023, inclusive.

For data extraction, was utilized EndNote for reference management and data extraction. Extracted data included region (Africa, Latin America, Brazil), fish species targeted, specific processing techniques employed, market focus (fairs, informal), economic and social impacts (income generation, food security) and challenges and opportunities related to value-added processing in SSFs.

For the last, data analysis was held descriptively, conducted to categorize and summarize the extracted data. Trends were analysed in processing techniques, targeted species, market access, and socio-economic impacts across different regions, focusing on Brazil. Comparative analysis performed to identify similarities and differences in approaches and challenges faced by SSFs in Africa and Latin America.

3. Results

This review investigates value-added processing techniques employed by small-scale fisheries (SSFs) in Africa, Latin America, and Brazil, with a focus on supplying products to fairs

and informal markets. The analysis reveals a diverse landscape of methods, tailored to specific fish species and market preferences, often relying on readily available resources and traditional knowledge.

In small pelagic fish, including anchoveta and sardines, are highlighted drying and salting technologies. These traditional techniques are widely used in Africa and Latin America due to their simplicity and effectiveness in extending shelf life (Belton et al., 2018; Jaffry et al., 2020). Sun drying remains prevalent, especially in rural areas. Fish are typically laid out on drying racks or mats, exposed to direct sunlight and natural ventilation. This process can be time-consuming (taking days depending on weather conditions) and susceptible to spoilage due to varying temperatures and insect infestation (Jaffry et al., 2020). However, the simplicity and minimal equipment requirements make it readily accessible.

In salting, another technique, salt is applied directly to the fish, drawing out moisture and inhibiting bacterial growth, although are not known specifically which bacteria are inhibited. This method, often combined with drying, further enhances shelf life and preservation (Jaffry et al., 2020).

Solar driers technology arises as a group of techniques with heterogenous applications and devices, while sun drying remains common, improved technologies like solar dryers offer better quality and longer shelf life, making them suitable for fairs and informal markets with limited refrigeration. These dryers utilize solar panels to convert sunlight into electricity, which powers fans and dehumidifiers, accelerating the drying process and offering greater control over temperature and humidity (FAO, 2018). Compared to sun drying, solar dryers are faster, more efficient, and produce a more consistent product with improved hygiene and reduced spoilage risk.

Considering catfish in West Africa, smoking is a common technique that offers a distinct flavour and extended shelf life. Fish are placed in a smoking chamber and exposed to smoke generated by burning wood or other materials like coconut shells. The smoke imparts flavour and inhibits bacterial growth, also not quite described, but proper smoke generation and handling are crucial for safety (Al-Belaghi et al., 2018; Kelleher et al., 2007). Traditional smoking methods often involve simple smoking chambers constructed from local materials, requiring careful monitoring to ensure consistent smoke quality and avoid incomplete combustion, which can generate harmful carcinogens.

Brazilian sea bass, may be benefited from filleting, in which the common technique removes the head, bones, and skin of the fish, resulting in boneless fillets with higher market value and easier preparation for consumers (Belton et al., 2018). While basic filleting can be done manually, it requires skilled labour. For larger-scale operations, mechanical filleting machines can be employed to increase efficiency and consistency, especially for premium species like sea bass. However, these machines require significant investment and technical expertise, potentially limiting their accessibility for smaller fisheries.

Preferences according region act like vectors in technology development. Fermented fish products like pada in Ghana and peixe podre in Brazil cater to specific cultural preferences and require unique processing methods and knowledge transmission (Aasha et al., 2014; Menezes et al., 2010). These techniques often involve traditional knowledge and skills passed down through generations, utilizing natural fermentation processes to enhance flavour, texture, and shelf life. Depending on the specific product and region, the methods can vary, involving salting, gutting, and controlled fermentation under specific temperature and humidity conditions.

Studies in Senegal state of technique and the Philippines traditions showed that value-added processing allows fishers to capture a larger share of the value chain, leading to increased income, being Senegalese small-scale fisheries widely susceptible to use and improve technologies related to manual fish grinder, grouping different species (Belton et al., 2018; Kelleher et al., 2007).

The diverse landscape across Africa, Latin America, and Brazil employs various value-added processing techniques, often relying on a combination of traditional knowledge, readily available resources, and innovative adaptations. Understanding the specific species, technologies, and their limitations is crucial for promoting effective implementation and supporting these communities in enhancing their economic and social well-being. Further development and adoption of improved technologies like solar dryers can offer significant benefits by enhancing product quality, shelf life, and market access, while respecting cultural preferences and traditional knowledge.

In Senegal, a popular value-added product within small-scale fisheries is ground smoked fish, locally known as Poissons Fumés Moulus (PFM) or minced fillet in its intermediate state (Cisse et al., 2017). Grinding allows to utilize the entire fish, including less valuable parts like bones and heads, minimizing waste and increasing product value (Cisse et al., 2017).

Smoking and grinding further extend the shelf life of the fish, reducing post-harvest losses and making it suitable for transportation and storage, particularly relevant for reaching wider markets (Cisse et al., 2017). The ground form provides a convenient and versatile ingredient for consumers, easily incorporated into various dishes like stews and sauces.

The traditional processing method involves smoking, sun drying, and mainly grinding. The dried fish are then manually ground using mortar and pestle or, in some cases, with small-scale mechanical grinding machines (Cisse et al., 2017, FAO, 2018).

Investing in accessible and affordable mechanical grinding equipment can enhance product consistency and production capacity (Cisse et al., 2017). Training programs on hygiene, food safety practices, and improved processing techniques can empower SSFs to meet market requirements (FAO, 2018).

By addressing these challenges and capitalizing on opportunities, the production and marketing of PFM can play a significant role in supporting the economic and social development of Senegalese fisheries.

4. Conclusion

This review aimed to highlight and evidence the wide, heterogeneous and simple in comparison to industrial scenario, technology involved in food safety of emergent countries, specially in small-scale fisheries. It is mandatory to enhance investment in traditional technologies, keeping cultural sovereignty in food choices.

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