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The U.S. Government's Global Hunger & Food Security Initiative

*Focus group discussion group at Mbaling processing site. Photo credit: Dr. Babacar Sene.*

# FEED THE FUTURE
# BUSINESS DRIVERS FOR FOOD SAFETY

Cooperative Agreement No.720BFS19CA00001

## BARRIERS TO ADOPTING SAFER FISH SMOKING PRACTICES AMONG SENEGALESE ARTISANAL PROCESSORS

*Technical Learning Note*

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## Overview

In Senegal, artisanally processed fish is an important component of the economy and diet. In 2018, nearly 40,000 tons of fish were processed, worth an estimated $47.5 Million USD. The main types of processed fish include: kéthiakh which represents 63%, guédji 17%, tambadjang 6%, and methora 5% (Ministère des Pêches et de l' Economie Maritime, 2019). Fish processing is labor intensive and provides many jobs, making it an important source of income generation in coastal communities which often suffer high levels of poverty and unemployment. Women represent over 90% of workers in the fish processing associations (University of Rhode Island [URI], 2018). This is particularly important as women typically contribute more of their income to household well-being and nutrition than their male counterparts, helping fight impoverishment and hunger.

As important as fish processing is for coastal economies and as a major contributor to household nutrition, there are associated health risks that come unbeknownst to many Senegalese. Some of the main health risks associated with fish processing and the consumption of processed fish include smoke inhalation during processing, consuming contaminated or spoiled products, and the consumption of polycyclic aromatic hydrocarbons (PAHs) which have genotoxic, carcinogenic, and teratogenic effects (Ifegwu & Anyakora, 2015) Of the four main types of processed fish, kéthiakh and methora are braised and smoked, respectively, and because of these processing techniques they contain relatively high levels of PAHs. Guédji and tambadjang are fermented and dried rather than smoked and therefore are not at risk of containing PAHs.

Throughout parts of West Africa, numerous organizations have conducted research and outreach activities addressing risks associated with food processing, especially seafood. In particular, the University of Rhode Island's Sustainable Fisheries Management Project (SFMP) in Ghana looked at many aspects of the processing system (SNV Ghana, 2020). Feed the Future Business Drivers for Food Safety (BD4FS), funded by USAID and implemented by Food Enterprise Solutions, is building off the findings and frameworks from the SFMP and other projects; and is utilizing available knowledge to help create a lasting impact in Senegal.

In 2020, BD4FS undertook a Food Safety Situational Analysis (FSSA) of the artisanal seafood sector in Senegal and confirmed that traditional smoking of fish remains a common practice (Food Enterprise Solutions [FES], 2020). BD4FS also completed a desk review of the health risks associated with consuming smoked products, the different types of fish smokers and the levels of PAHs produced by each smoker, as well as costs and financing options for adopting modern smokers that produce lower PAH levels (FES, 2021). Based on findings from the literature review (FES, 2020), focus group discussions (FGDs) were held with women's associations of artisanal fish processors in Senegal to better understand their knowledge of PAHs, and to identify gaps and barriers within the food system that need to be overcome in order to improve the health and wellbeing of processors and consumers. FGDs were held at processing sites within the greater Dakar region and in the Petite Côte area south of Dakar in early spring of 2021.

Focus group discussion group at Mbaling processing site. Photo credit: Dr. Babacar Sene.

The key objectives for the FGDs were:

- Assess the knowledge, attitudes, and practices of artisanal fish processors regarding PAHs in smoked and braised products
- Examine the processes and viability of introducing new fish smokers /ovens to the processing communities
- Better understand why processors resort back to traditional processing techniques
- Understand why many donor-funded projects fail to achieve lasting impacts on the processing communities

The FGD methodology is described in more detail in Appendix 1.

# Results

Through the FGDs, the BD4FS team gained insight on local knowledge regarding fish processing that was generously shared by the local associations of women fish processors. In total, 163 processors from 7 different sites participated in the FGDs. For more information on FGD sites and participants, see Appendix 2.

## Processing

### Preparation of Kéthiakh

*Sardinella* spp. is the main type of fish used for producing the two varieties of kéthiakh - salted and unsalted. Processors reported that their unsalted kéthiakh is produced using an oven or fish braiser, where fish are placed head down on grates. After braising and cooling, the fish are removed and placed under a tarpaulin to sit for one night. The next day, the fish are beheaded and gutted, and then placed into the open air for approximately three days to completely dry under the sun. Once dry, the fish are packaged and stored before being transported and sold.

Men packing the fish braiser with fish, positioned heads down, to produce kéthiakh. Photo credit: Dr. Babacar Sene.

Women described two ways of processing the salted kéthiakh variety. The main variable determining the processing technique is accessibility to an oven or fish braiser. When women do not have access to an oven or fish braiser, the fish are spread on the ground, covered with fuel and braised with an intense fire for thirty minutes to an hour. After cooling, the fish are removed, beheaded, trimmed, and salted in basins for one half day. After salting, the fish are spread on racks for two to four additional days to dry. When a processor has access to an oven, the fish are stowed head down on oven grates and covered with galvanized iron sheets. The oven is then filled with straw or other fuel by men who are employed by the women to do the difficult tasks. The fish are braised with very intense fire for 30 minutes to an hour. After cooling, the fish are removed, beheaded, trimmed, and salted in basins for one half day, exactly as in the previous case. After salting, the fish are spread on racks for drying.

### Preparation of Methora

Methora is smoked fish, typically produced from *Arius latiscutatus Günther* (known as kong in Wolof) and *Sardinella* spp. The fish are placed in the oven and cooked with a low heat for one to two hours depending on the size and quantity of the fish. Shavings are then added to the furnace to produce more smoke and the fish are left for another one to two hours to give it the desired aroma and color. During this smoking process, the fish are rotated to ensure uniform smoking. Processors identified three different pathways for fish smoking (diagrammed in Appendix 3). One of the main differences between the three lies in the brining step in the middle of the process: some processors choose not to brine their fish (method 1), some choose to brine it using spices (method 2), and others choose to use the traditional brine using just salt (method 3).

### Fish Smoking Ovens

From the literature review that preceded this study (SNV Ghana, 2020), a question that arose was, "what ovens are actually used in Senegal?" FGDs revealed that traditional smoking technology has been studied extensively and that over the past decades many modifications have been made, or at least attempted, to improve efficiency of the ovens and product quality. The discussions also revealed that several different oven types can be found in the studied localities and, by inference, throughout Senegal; however, many of the newer types and even some older models have been abandoned by processors and have fallen into disrepair. The oven models mentioned in the roundtable discussions included 1) the traditional basic brick oven, 2) a modified brick oven, 3) the Altona oven, and 4) the FAO Thiaroye oven (also known as FTT, acronym for "FAO Thiaroye (processing) Technique which reduces PAH creation") (FES, 2020). Of the four ovens mentioned, discussions revealed that the only oven that is still being widely used is the traditional brick oven. Processors mentioned the reasons they prefer this oven is due to the quantity of fish that can be processed in one batch. Interestingly, throughout the site visits, not one FTT oven was found to be operational. All FTTs were found to either be under construction (funded by Government of Senegal through the Directorate of Fisheries Processing Industries, DIPT) or have fallen into disrepair.

### Fuel

The type and quantity of fuel used contribute to the synthesis of PAHs, and research has shown a positive correlation between PAH and lignin content (FES, 2020). Because of this, BD4FS was interested in evaluating the type of fuel used for processing. The FGDs revealed that various fuels are used throughout Senegal for braising and smoking, including baobab trunk, sawdust, straw, wastepaper, and cardboard. These findings are concerning as wastepaper is often contaminated with dyes and inks that can contain heavy metals like cadmium and lead. The intake or somatic absorption of these heavy metals has been linked to a variety of health problems including birth defects, kidney and liver failure, and interference with red blood cell production (Zender Environmental for Institute of Tribal Environmental Professionals & Central Council Tlingit Haida Tribes of Alaska Solid Waste Alaska Network, 2005). Therefore, in addition to PAHs, the presence of heavy metals in the smoke and in the final processed fish products constitutes a potentially high health hazard to both processors and consumers.

Waste products, mostly different types of paper and cardboard that end up being used as fuel at the Rufisque site. Photo credit: Dr. Babacar Sene.

Traditional ovens were reported to consume more fuel than the newer modified ovens (e.g., Altona, FTT Thiaroye). Modified ovens are equipped with a cover and a door, reducing their energy consumption because there is a better retention of heat and smoke.

## Food safety and occupational health

### PAH awareness

Many processors were aware that their smoked and braised fish produced with traditional ovens do not meet required food safety standards. The FGDs revealed, however, that they lack awareness of PAHs. When asked if anyone could tell the BD4FS team what they knew about PAHs, processors at all sites were unable to answer despite many having been trained in smoking and braising techniques. After informing the FGD participants about PAHs, they indicated a desire to have ovens that can better control PAH levels in products.

### Occupational health

The most common health concern of processors was respiratory problems. This health issue was mentioned at all sites during discussions. Women believed the cause of the respiratory issues was due to a combination of poor oven design and excessive amounts of fuel being used. In addition, processors mentioned that respiratory problems arise when processing ethmalose (bonga shad, *Ethmalosa fimbriata*), a fish species locally abundant along Africa's Atlantic coast. This is due to excessive amounts of dust particles in the air from the ethmalose being sprinkled with ash or sand to allow for easier handling. Women processors did not report any major eye health problems related to smoke exposure. However, women processors who make kéthiakh said that smoke made their eyes water during braising. Other issues that were mentioned in the focus group discussions were burns resulting from fire or hot surfaces, and rheumatism as a result from standing for long periods of time.

## Lessons learned from past projects

Over the past two or three decades, numerous projects have been implemented in Senegal aiming to supply the processing sites with the equipment needed to improve the working conditions of fish processors and the quality of products. However, this study among others discovered that once the projects were completed, the equipment was frequently abandoned by the intended beneficiaries of the project. The FGDs inquired as to why this occurs. Reasons mentioned for the abandonment of donor-financed ovens included: 1) technical inadequacies, 2) low ratio of stoves to members, 3) inconsistent fish supply, 4) operating capital constraints, and 5) non-inclusive design and dissemination processes.

### 1. Technical Inadequacies

The women processors cited the following as some of the major technical reasons for not adopting the stoves promoted by previous projects: taste and texture alteration, susceptibility of the construction materials to weathering, and limited volume capacity. In terms of taste and texture, the women processors noted that consumers tell them that fish smoked in traditional ovens taste better and feel different than fish smoked in modern ovens. However, sensory analysis tests have not been conducted to verify these differences between the two products. Ability to weather the harsh coastal working environment was another factor identified by the FDGs. As all processing sites are located next to the sea, the ambient conditions are humid and loaded with salt, causing metal to rust whereas traditional brick overs are not susceptible to rust. The smoker ovens would need to be built with more suitable materials like stainless steel which would likely be cost prohibitive. Finally, the various promoted ovens do not hold enough fish in one setting, which means that processors need to put in more effort per batch and it takes longer to cook the same volume of fish than with a traditional oven. This greater level of effort required, plus perceived changes in the quality of the product that consumers expect and demand, along with poor physical durability, made the promoted stoves less attractive to these women entrepreneurs.

### 2. Ratio of Stoves to Members

Throughout the FGDs, many of the processors mentioned that another reason for abandonment of the ovens was the insufficient number of ovens distributed per locality, per association. Access to smoking technology is always a concern for the individual processor. As seen in Figure 2 in Appendix 2, some of the processing sites are extremely large and host many processors. For an association of women fish processors, this means that the new ovens would become a communal oven to be shared. The limited number of promoted stoves creates problems in terms of organizational operations, decision-making processes, and financial management, requiring associations to determine who gets access, when, and for how long.

### 3. Inconsistent Fish Supply

One of the most important reasons mentioned by processors for failure of oven projects is the inconsistent supply of fish to process. During the study period (March 2021), the scarcity of fish experienced by fishermen and processors was readily observed. During site visits, women groups went for days without having any fish to process. When there are fish, it is necessary to be able to process them quickly since processing sites do not have adequate cold storage facilities. Given the sporadic nature of supply, processors require ovens that have a large enough capacity to handle periods of high volume and that also do not require high time and capital investment to avoid losing money when they face regular shortages of fish to process.

### 4. Operating Capital Constraints

The women fish processors are basically independent entrepreneurs. They operate on very thin margins and with the inconsistent supply of fish, their limited operating capital fluctuates accordingly. The market for processed products (smoked fish and kéthiakh) is highly dependent on buyers from Guinea and Burkina Faso. These buyers stop buying when the fish does not meet their quality standards, especially if the fish is very fatty and hence prone to rancidity. As a result of this rejection, Senegalese processors sometimes find themselves with stocks of product that they must sell on the local market at discounted prices. This low margin business, subject to supply problems and recurring market rejection, makes these women entrepreneurs risk adverse and hesitant to adopt new technologies that cost more in terms of time and effort, and that may alter the taste and texture to the consumer.

### 5. Non-inclusive Design and Dissemination Processes

There have been several projects to finance improved stoves in Senegal in the past, but most have failed to achieve significant uptake of promoted stoves. According to the women processors, uptake could have been improved if they had been consulted in the design of the ovens and if their criteria of capacity and ease of operation had been incorporated. On the contrary, the ovens distributed to them as already finished products have low capacities and are more difficult to use than traditional, larger-capacity ovens. Many of these problems could have been avoided with a more inclusive, participatory approach to identifying the specific needs of the processors in each site. Offering an even more critical viewpoint, some processors stated that engagement and co-design with the women is crucial and that the process must take into consideration their cultural, social, and economic values rather than promoting off-the-shelf technologies that might work elsewhere.

# Summary of findings and recommendations

## Key findings

Through the FGDs and site visits, a main conclusion is that there are food safety concerns in the fish product processing chain, particularly the smoking and braising operations. Despite attempted interventions of several projects that have financed equipment at processing sites to help improve working conditions and the quality of products, with special emphasis on replacing the traditional ovens with newer and safer ones, processors still resort back to the traditional ovens. Many of the processors are aware that their products produced with the traditional ovens do not meet required food safety standards. While their knowledge of PAHs is limited, they have a desire to have ovens that can better control PAH levels in products. Processors need to be actively engaged in projects from beginning to end to help design new ovens that consider cultural, economic, and social factors. Other recommendations processors gave include:

- Emphasize capacity and ease of use in the choice of ovens.
- Provide assistance in the development of markets as sometimes it is difficult for them to sell their products in their usual markets.
- Establish a financing mechanism for their activity by allocating credits with the lowest possible interest rates.
- Establish a monitoring and evaluation system for the objectives of the projects intended for them.

## Recommendations

Based on the FGDs, recommendations are summarized at the site-level, processing-level, and to assist processors.

At the site level

- Processing sites must be developed to comply with food safety standards.
- Sites must be equipped with appropriate infrastructure and equipment to improve hygiene and working conditions for processors.

At the processing level

- It is important that actions be taken to reduce the level of PAHs in fish products.
- Future projects should consider the production capacity, which seems to be the most important element in the eyes of women processors.
- Efforts should be made to raise awareness amongst processors regarding the choice of fuels used.

Regarding the processors

- A capacity building program for processors should be considered. This program should focus on smoking and braising techniques, good hygiene practices, and basic accounting and financial management.
- Establishment of a financing fund that grants loans to women would be beneficial, as all women at the seven processing sites visited mentioned the lack of working capital.

## Study Challenges

The BD4FS team experienced some unforeseen challenges during this project. First and foremost was dealing with the difficulties that the COVID-19 pandemic has created. This prevented several team members from being present in Senegal to help conduct this critical research. Another difficulty was the political tension in Senegal during the timing of this research. Due to this, some of the meetings scheduled with processors needed to be postponed until tensions had settled. Lastly, this study occurred during a period of low fish landings and many of the women did not commute to the processing sites during this time. This made finding processors who could participate in the research more difficult.

# Appendices

## Appendix 1: Methodology

BD4FS Technical Specialist, Dr. Babacar Sene, conducted this qualitative study that used primarily focus group discussions (FDGs) with women fish processors from March 9 to 21, 2021 in Dakar, Mbour, and Joal. From these areas following processing sites were selected: Yoff, Thiaroye, Rufisque and Bargny (all in Dakar), Mbaling (in Mbour), and Khelcom and Tann bi (both in Joal). Sites were selected according to the nature of their activities, production volume, and geographical location. The sites selected are the most important smoked fish and kéthiakh production sites in Dakar and surrounding areas. The topics outline below was developed by the BD4FS research team to guide the FGDs with associations of women processors. Formal representatives of the associations granted permission to conduct the FGDs which were carried out according to the schedule in Table 1. All FGDs were conducted in the Wolof language to overcome language barriers and incentivize maximum participation of all the attendants. Participants were asked if they would give their consent to conduct the FGDs with recording and photo documentation, and they were guaranteed that all information given would remain anonymous. Each FGD lasted between 90 and 120 minutes. At the end of each FGD, a sign-in sheet was passed around to collect names, age of participants, and what product(s) the participants processed.

### Key topics explored in the focus groups

1. There is very little information regarding the model smokers that processors are using. Could you tell us about the model smoker that you currently use and why you use it?
2. Can you please describe your process of smoking fish?
3. Can you please describe your process of braising fish?
4. Going back to smoker models, have you changed your smoker model?
    a. If yes, why did you change your model?
5. Have you been invited to participate in projects asking you to change your model smoker?
    a. If yes, did you end up participating in the project? If you chose not to participate, why not?
    b. If yes, are you still using that model smoker?
    c. If no, what are the reasons why you are not using the model smoker that was used as part of that project?
6. One point of interest that Food Enterprise Solutions has is polycyclic aromatic hydrocarbons, better known as PAHs. Has anyone in the group ever heard of PAHs, and if so, can you tell us what you know about them?
7. Just so everyone knows, polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals that occur whenever a substance is burned. The effects of PAHs on the body are unknown, but some PAHs may cause cancer and may affect the eyes, kidneys, and liver. Humans are most likely to come into contact with PAHs through consumption of food that has been processed by smoking, grilling, braising and other cooking methods.
8. In your opinion, what are the biggest health concerns of processors regarding their work?

a. Are PAHs a concern of processors? And do processors take into consideration the amount of PAH in their product?

b. If you didn't before, now knowing what PAHs are, do you think it's a good idea to take into consideration the amount of PAHs?

9. Have you ever been trained on technologies to reduce PAHs?
    a. If yes, are you using these technologies or have you resorted back to traditional techniques? (We need to ask if we can ask who provided the training)
    b. If you resorted back, can you explain why you have resorted back to traditional techniques?
10. If you have not received training regarding PAH reducing technology, do you think it would be beneficial for processors to learn techniques to reduce PAH in their products, why or why not?
11. The last couple topics we would like to discuss regard previous and future projects.
12. Regarding smoking technology, what training or projects do you think would be beneficial to fish processors and why?
13. There have been numerous projects conducted in Senegal related to smokers and smoking activities. Many of these projects and activities often fail to have or create a lasting impact on processors. In your opinion, why do projects fail and processors resort back to their previous methods?
14. Our last question is that we want to create lasting and sustainable projects that have an impact on the processor communities in Senegal. In your opinion, what creates a successful project that has a lasting impact?
15. On behalf of myself and Food Enterprise Solutions, we would very much like to thank you for participating in our roundtable discussion. If you have any questions, please feel free to ask.

## Appendix 2: FGD Sites and Participants

*Table 1: Date and location of focus group discussions, and number of attendees.*

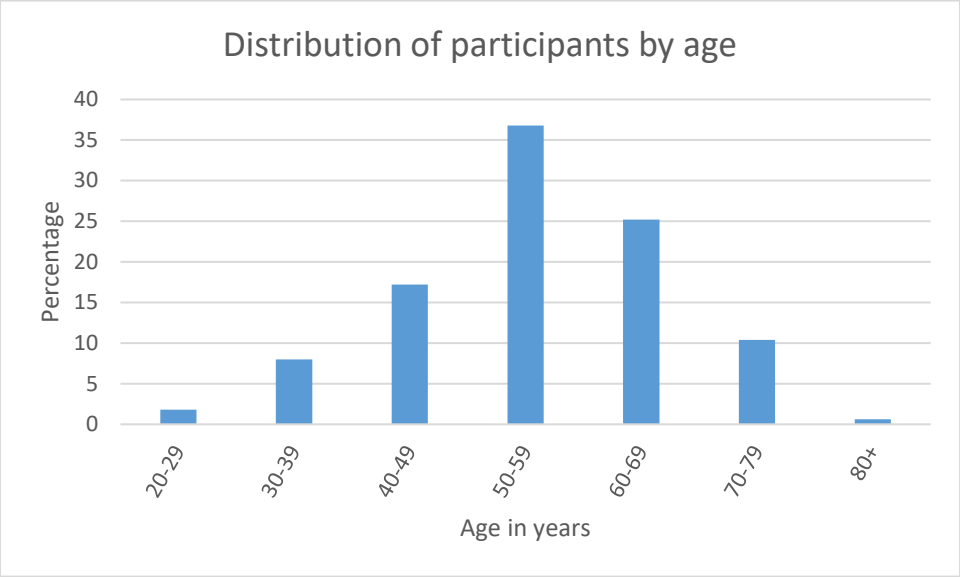
| Date of holding the focus groups | Processing site | Number of attendees |
|---|---|---|
| March 9, 2021 | Seuty Ndiaré /Yoff | 3 |
| March 10, 2021 | Penccum Sénégal/ Thiaroye | 22 |
| March 11, 2021 | Domaine Gouye Ndioulankar/ Bargny | 28 |
| March 13,2021 | Groupement book Dio/ Rufisque | 33 |
| March 19,2021 | Mbaling/ Mbour | 14 |
| March 26, 2021 | Khelcom | 39 |
| March 26, 2021 | Tann bi/ Joal | 24 |

*Table 2: Estimated number of processors at each site combined with minimum, maximum, and average age per site.*

The age range for focus group participants was 58 years. The youngest processor to participate in the FGDs was from the Penccum Senegal/Thiaroye site and was 22 years old, and the oldest processor was from the Domaine Gouye Ndioulankar/ Bargny site, and was 80 years old. The average age of participants in the discussion was 52 years old. Site population size (e.g., number of members at each local association, or number of users of the processing facilities) also varied greatly, with the smallest site being Seuty Ndiare/Yoff with an estimated population size of 30, to Tann bi Joal with an estimated population of 6,000.

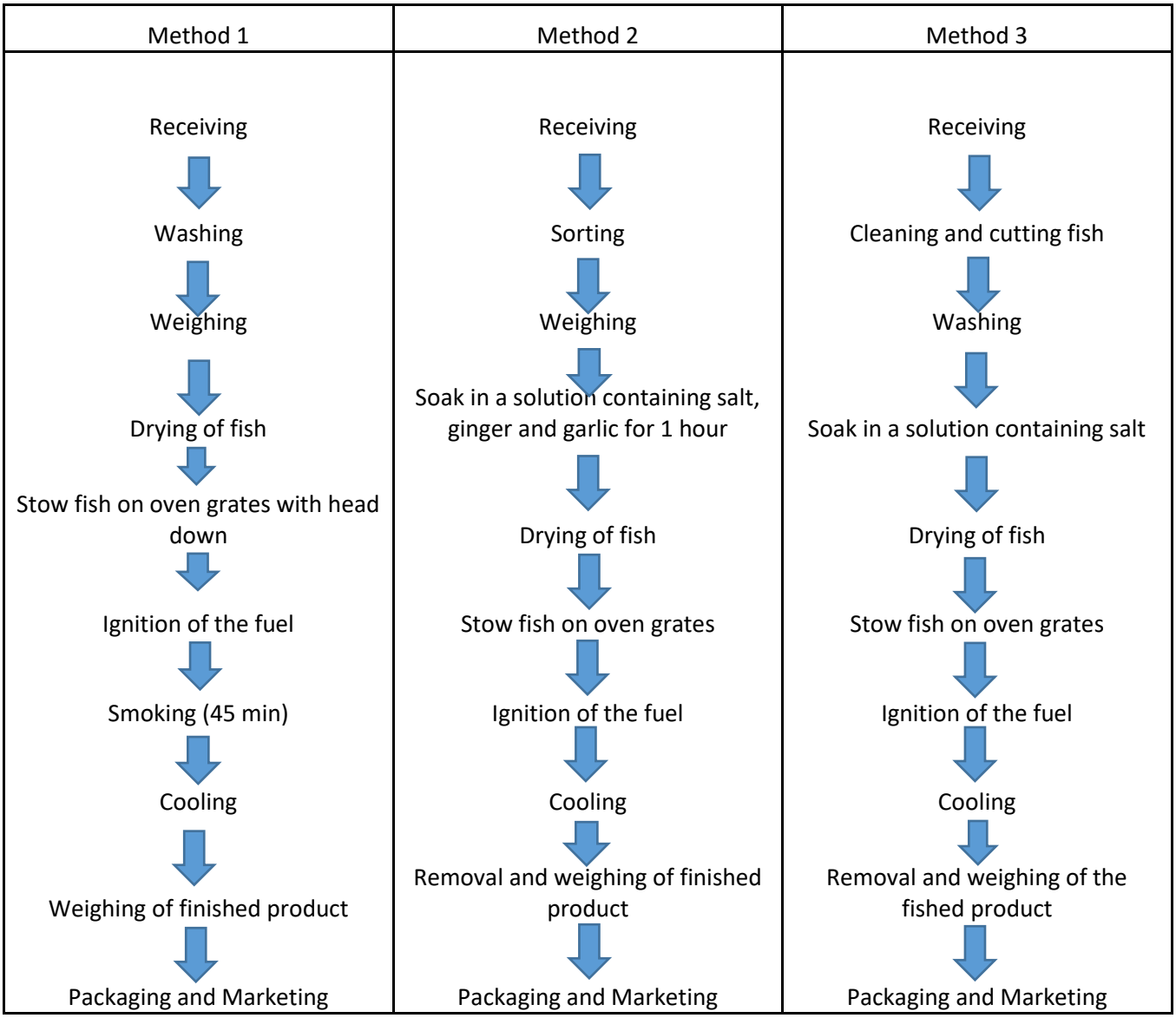
| Processing Site | Estimated population of the site | Average age | Minimum age | Maximum age |
|---|---|---|---|---|
| Seuty Ndiaré Yoff | 30 | 46 | 32 | 55 |
| Penccum Senegal Thiaroye | 150 | 53 | 22 | 71 |
| Rufisque Groupement Book Diom Ndepé | 200 | 59 | 41 | 75 |
| Domaine Gouye Ndioulankar Bargny | 275 | 55 | 50 | 80 |
| Mbour Mbaling | 150 | 58 | 32 | 73 |
| Khelcom Joal | 400 | 51 | 26 | 68 |
| Tann bi Joal | 6000 | 45 | 28 | 60 |
| **Total** | **7205** | **52** | **22** | **80** |

*Figure 1: Age distribution of all focus group participants.*



## Appendix 3: Fish Smoking Technique

*Figure 2: Flow diagram of three different Methora cooking methods.*



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