



FEED THE FUTURE

Business Drivers for Food Safety

Summary of the Food Safety Situational Analysis of the Artisanal Seafood Sector in Senegal

Technical Learning Note

September 2020

Cover image: Fishers in pirogues at Lampoul landing site. Photo by Juan Vilata-Simon

Overview

Seafood is a critical source of nutrition in Senegal, especially among populations with low incomes. Post-catch processing, distribution and retailing are also a source of employment and income: in addition to fresh seafood sold near the point of catch, a significant amount gets processed (salted and smoked) and sold further inland and cross-border to neighboring countries. This important commodity for Senegal's food security comes with important public health and food safety challenges. Many handling practices along the supply chain – cleaning, smoking, salting, drying, transporting and retailing – can contribute to loss of potential nutrients for consumers as well as losses of income and profit to businesses. In addition, poor food safety practices set the stage for transmission of food borne pathogens.

From March – July 2020, Business Drivers for Food Safety (BD4FS) carried out an assessment of conditions in Senegal that affect the ability of supply-chain actors - fisherfolk, fish processors, fishmongers, vendors, technology suppliers and transporters – to adopt food safety practices. The initial focus for this Food Safety Situational Analysis (FSSA) was the artisanal fisheries sector¹, although some of our key findings also have relevance for other perishable food groups popular to Senegalese consumers. The steps in this analysis include desk research, appraisal of the artisanal fishery supply chain from post-capture to retail, field observations, interviews with local stakeholders and review of previous interventions in the sector.²

In addition to documenting the threats to public health presented by traditional handling of seafood catch, BD4FS also interviewed key actors in the private sector to better understand the constraints that businesses face to adopting food safety practices – financial, technological, regulatory, etc. These findings are the subject of this report and will be used in the next phase of the BD4FS Senegal project implementation. BD4FS will co-design possible solutions and explore the “drivers” for adopting food safety improvements alongside formal and informal supply-chain actors. BD4FS will monitor the implementation, adoption and outcomes of varying solutions to assess which have the greatest potential for impacting the development of food systems – by reducing loss and incidence of foodborne pathogens – that provide consumers with safe and nutritious food choices.

Impacts of COVID-19

FES's work on the FSSA was impeded by travel restrictions resulting from the COVID-19 pandemic. More importantly, artisanal fishers, processors and consumers suffered from decrease in supply and increase in price as a result of the curfews necessary to halt community spread.³ Still, the BD4FS team was able to conduct virtual interviews with key stakeholders in both government and business while carrying on with desk research.

¹ USAID Senegal gave FES concurrence to conduct an “Artisanal Fisheries Food Safety Situational Analysis” in January 2020.

² The BD4FS FSSA methodology has been adapted from a model developed by the International Livestock Research Institute (ILRI). See Alonso, S. 2019. Food safety in Africa. Presented at the Launch of Global Food Safety Partnership (GFSP) Report—Food Safety in Africa: Past Endeavors and Future Directions, Addis Ababa, 11 February 2019. Nairobi, Kenya: ILRI.

³ See BD4FS publication “COVID-19 Jeopardises the Artisanal Fish Supply and Trade in Senegal,” <https://www.agrilinks.org/post/covid-19-jeopardises-artisanal-fish-supply-and-trade-senegal>.

The Importance of Fisheries to the Diet and Economy of Senegal

A staple food: With the advantage of a 718 km coastline, the fisheries sector makes a significant contribution to Senegal's economy.⁴ The country's per capita fish consumption in Africa at 36 kg per year, and contributes 15 percent of protein from fish, especially small *pelagic* species.

A source of jobs and income: An estimated 60 percent of the population is employed primarily in artisanal fisheries and traditional fish processing. The commercial/industrial sector produces about 2 percent of the total. The sector represents 80 percent and employs an estimated 1 million people. Fish production and trade represents about 3 percent of the country's GDP.



Key Factors Impacting Food Safety

Cleanliness: Most traditional seafood processors lack access to safe water facilities, and many processing sites are situated near biohazards such as open sewers or open refuse sites, creating opportunity for bacterial contamination.⁷

Toxic contamination: Smoked fish is widely traded and consumed in Senegal and the entire West African region and is even exported internationally. Traditional methods for smoking fish are often done using hazardous fuel materials such as discarded paper, cardboard, wood and even plastic. Plastic is particularly hazardous because it emits *polycyclic aromatic hydrocarbons* (PAHs) that are both teratogenic and carcinogenic.⁸

Cold chain logistics⁹: Outside of the export sector, cold chain logistics, including temperature-controlled transportation, is inconsistent. Most seafood destined for local consumption through retail vendors, with the notable exception of supermarket chains, is not adequately chilled due to deficiencies in infrastructure, lack of proper cooling equipment like chilling boxes and lack of ice. While

Unusable stoves at Joal processing site. Photo by Juan Vilata-Simon

⁴ Food and Agriculture Organization of the United Nations Fishery and Aquaculture Country Profiles the Republic of Senegal Updated 04-2017 www.fao.org/fishery/facp/SEN/en

⁵ Belhabib, D., Koutob, V., Sall, A., Lam, V. W., & Pauly, D. (2014). Fisheries catch misreporting and its implications: The case of Senegal. *Fisheries Research*, 151, 1-11. Retrieved from: <https://bit.ly/2Vv86oy>

Diop, M., Howsam, M., Diop, C., Cazier, F., Goossens, J. F., Diouf, A., & Amara, R. (2016). Spatial and seasonal variations of trace elements concentrations in liver and muscle of round Sardinella (*Sardinella aurita*) and Senegalese sole (*Solea senegalensis*) along the Senegalese coast. *Chemosphere*, 144, 758-766.

⁶ Bank, S. & Thiam, M. (2018). CBI Senegal Value Chain Analysis Summary Report. 39 pp. Literally from the source: "Artisanal fisheries represent 80–90percent of Senegal's total catch volume"

⁷ Possible bacteria in seafood include: *Bacillus cereus*, *Campylobacter jejuni*, *Clostridium botulinum*, *Clostridium perfringens*, *Pathogenic Escherichia coli*, *Listeria monocytogenes*, *Salmonella spp.*, *Shigella spp.*, *Pathogenic Staphylococcus aureus*, *Vibrio cholerae*, *Vibrio parahaemolyticus*, *Vibrio vulnificus*, *Yersinia enterocolitica*, and others.

⁸ Teratogenic - Causing malformations or defects to an embryo or fetus. Carcinogenic - Causing or tending to cause cancer.

⁹ A cold chain is a temperature-controlled supply chain. An unbroken cold chain is an uninterrupted series of storage and distribution activities which maintains a temperature range. It is used to help extend and ensure the shelf life of products such as fresh agricultural produce, seafood, frozen food, photographic film, chemicals and pharmaceutical drugs.

ice is available, its distribution appears to be spotty and many retail vendors in local markets are unaware of the importance of temperature control or cannot afford it.

Access to finance: Most small and growing food businesses (GFBs) in the artisanal seafood sector operate with minimal capital investments and very low margins. The formal financial system does not traditionally invest in this sector, which is viewed as risky by many financial institutions.

Profile of Foodborne Pathogens from Seafood and Mitigating Factors

A key measure for BD4FS is the presence of foodborne pathogens along supply chains being studied. The FSSA team classified seafood hazards by causal agent: bacteria, viruses, parasites, heavy metals, microplastics, histamine poisoning, biotoxins and organic chemical pollutants. To facilitate this analysis, FES developed a matrix in which each hazard is gauged against three criteria: ease of detection, level of risk to the consumer public, and feasibility of mitigating actions. “Feasibility of mitigating actions” to be taken by supply-chain actors were in turn assigned three levels of difficulty: low, medium and high.

From this exercise, FES identified four areas of intervention that have potential for impacting food safety:



Braised and salted fish at Mballing processing site. Photo by Juan Vilata-Simon

Reduce bacterial contamination:

Landing and processing sites visited during the FSSA showed a conspicuous absence of clean water, sanitation and hygiene (WASH) facilities and a general lack of cleanliness in work areas. To better understand these unsanitary conditions, BD4FS has commissioned a WASH assessment to examine this issue, especially since past donor investments in both WASH facilities and improved workstations have met mixed results.

Reduce chemical and toxicant

contamination: To explore options for reducing the presence of PAH toxins in smoked fish, FES is partnering with The Coastal Resources Center at the University of Rhode Island to study how varying stove technologies – e.g. the *Thiaroye* and *Ahotor* stoves – impact levels of PAHs and how well they are accepted by women processors, who are major actors in this sector.

Improve cold chain logistics: Cold chain logistics¹⁰ is a major factor for seafood safety, as it is for all perishable food products. The FSSA team observed problems all along the value chain – from inadequate onboard storage of seafood catch to lack of electricity and refrigeration at landing and processing sites, and inadequate or absent ice throughout the chain. Given the importance of the cold chain for seafood preservation, as well as for other value chains such as fresh fruits and vegetables and animal-sourced foods, BD4FS will be commissioning a more detailed analysis of the cold chain logistics in Senegal to identify opportunities to build this capacity.

¹⁰ Cold chain logistics – moving temperature-sensitive food products through the supply chain while maintaining quality and safety.

Improve access to finance: Small and growing food businesses in most food systems face limited revenue flows, high operational costs and low-volume sales, hence, the adoption of new technologies and food handling practices may incur costs that these businesses see as risky and unaffordable. This impediment negatively affects most supply chains, not just fisheries. To better understand these dynamics, BD4FS has commissioned a financial landscape analysis to advance the understanding of the financial constraints from both supply and demand perspectives – and inform approaches that BD4FS will undertake to encourage financial and non-financial services to upgrade food safety technologies and protocols.

<i>Threats to Food Safety Along Artisanal Fisheries Supply Chain</i>	
Type of Business	Food Safety Issues
Capture	<ul style="list-style-type: none"> • Lack of onboard storage and cold chain logistics, such as the use of refrigeration, ice, shade, etc. • Extended periods offshore • Contaminated waters = contaminated fish
Landing	<ul style="list-style-type: none"> • Lack of hygienic crating materials • Lack of cold chain logistics • Hazardous location – open sewers, refuse sites
Local transport	<ul style="list-style-type: none"> • Use of open containers, horse carts to move product • Lack of cold chain logistics
Processing	<ul style="list-style-type: none"> • Contaminated or unclean processing surfaces, equipment • Lack safe water source for cleaning • Lack of cold chain logistics • Salting and smoking practices can introduce contaminants
Inter-regional transport	<ul style="list-style-type: none"> • Transport of processed products in unsanitary conditions • Lack of cold chain logistics

(Note: See Annex I for more on contaminants and supply chain points of entry).

Urban Supermarkets: Potential “Pull” Businesses to Promote Food Safety

Incentivizing adoption of food safety practices is a key objective for BD4FS. This is particularly challenging in the absence of an enabling regulatory environment. However, some opportunities may exist. Several major supermarkets in Dakar and other urban centers sell artisanal fish products and typically offer better conditions for storing and displaying their food goods. The FSSA team met with several supermarkets to observe their operations, understand their buying practices and explore how they could increase market demand for seafood that is captured, processed and transported according to higher standards of food safety. Some of the key characteristics of these food system actors include:

Fish flows in the market: Some retailers, such as supermarkets, restaurants and seafood exporting companies, source a significant part of their products from the artisanal seafood supply chain. Generally, they purchase seafood via field agents or aggregators that buy fish directly from fishermen upon landing.

Quality standards: Some supermarket retailers and exporters require a high-quality standard for the seafood they purchase and are quite strict in demanding quality products. In so doing, they make the independent local agents from whom they purchase seafood responsible for ensuring that their standards are achieved. These agents know that if they expect to sell to these supermarkets and exporters, they must provide them with quality product or there will be no sale. The main criterion applied (besides maximum freshness of the seafood, determined by visual cues and experience) is temperature control, applied from the moment of capture to the moment the transport truck arrives to the point of delivery.

Maintaining cool and clean conditions: Strict temperature control combined with improved food hygiene and handling is an effective way to curb many seafood borne diseases caused by bacterial contamination. Most of the formal, medium-sized businesses interviewed reported minimal loss rates and low incidence of contamination because of their capacity to control for hygiene and temperature.

In the next phase of the project, BD4FS will engage these businesses and explore how their quality standards as buyers can influence more fishmongers to adopt better practices to expand their markets.



Saint Louis fish processors. Photo by Juan Vilata-Simon

Policy and Regulatory Environment

Many businesses in the artisanal fisheries sector are informal. Although this is a rational decision to remain outside the purview of tax or licensing authorities, health inspectors, etc., staying informal sets up a “glass ceiling” that naturally limits growth potential. Oftentimes the sheer complexity of regulations becomes a deterrent to supply chain actors. Although BD4FS is not designed to advise governments on their regulatory and enforcement policies, the project will facilitate open dialogue between businesses and government representatives that promotes business development, job creation, and economic growth.¹¹

The key government actors that manage the seafood sector include:

Ministère de la Pêche et de l'Économie Maritime, MPEM (Ministry of Fisheries and Maritime Economy):

This agency is responsible for the sustainable management of fisheries resources within the country's exclusive economic zone (EEZ). The three Ministry sub-departments that govern fisheries management are as follows: Direction des Pêches Maritimes, DPM (Department of Marine Fisheries); Direction de la Protection et de la Surveillance des Pêches, DPSP (Directorate of Fisheries Protection and Surveillance); and Direction des Industries de Transformations, DITP (Department of Fish Processing Industries).¹²

¹¹ The fisheries sector in Senegal is governed primarily by the *The Senegal Fisheries Act* which was approved in 2008.

¹² Alonso, S. 2019. Food safety in Africa. Presented at the Launch of Global Food Safety Partnership (GFSP) Report—Food Safety in Africa: Past Endeavors and Future Directions, Addis Ababa, 11 February 2019. Nairobi, Kenya: ILRI.

DPM is responsible for the design and implementation of sustainable development policies in marine fisheries and is the competent agency for the management of artisanal fisheries. DITP oversees the export-oriented processing plants and DPSP oversees all monitoring, surveillance and control (MSC) activities.

Conseil Local de Pêche Artisanale (CLPAs): Recently, there has been a partial shift towards implementing a more participatory approach in the management of fisheries, by which coastal communities have gained a small measure of management autonomy through the creation of local councils of artisanal fisheries (CLPAs). However, many CLPAs suffer from a severe lack of funds that affect their functionality,¹³ making them dependent on funds from international donors.

Other entities: In addition to the interplay between the central government (DPM, DITP and DPSP) and the CLPAs, there are also a number of national-level stakeholder associations such as the National Federation of Fish Traders (FENAGIE-PECHE), the National Federation of Senegalese Vessel Owners (FENAMS), the National Collective of Artisanal Fishermen of Senegal (CNPS), the National Federation of Women Fish Processors of Senegal (FENATRAMS), the National Interprofessional Council of Artisanal Fishermen of Senegal (CONIPAS), and Employers' Union of Wholesalers and Exporters of Senegal (UPAMES).

Health agencies: Food health hazards and foodborne diseases are under the purview of the *Ministère de la Santé et de l'Action Sociale* (Ministry of Health and Social Action) and the *Conseil National de Sécurité Alimentaire* (SE/CNSA, Senegal Commission on Food Safety), while the Food and Agriculture Organization of the United Nations' Codex Alimentarius provides guidance to the health authorities on food safety matters.

Supply chain nodes crucial to seafood health hazards

Though supply chains of artisanal caught seafood can be quite complex, smoked sardinella, which is widely consumed, serves as a good proxy for illustration purposes. The simplified sardinella supply chain includes five key nodes:

- Capture by pirogue (artisanal fishing vessel);
- Landing at rudimentary sites on the beach;
- Transport to processing sites (often close to landing sites);
- Artisanal processing (salting & smoking) with very basic technology; and
- Transport to final point of sale (which can be within Senegal or in other West African countries).

In each of the five nodes, there are unsanitary conditions that can amplify any existing foodborne hazards. Some of the conditions include:

Capture: Sardinella fishing boats (pirogues) often lack adequate fish holds. Hence, the fishers pour the contents of the net directly onto the bottom of the wooden pirogue, where the sardinella lies until landed. (Fishers who target species other than sardinella will use Styrofoam boxes of varying quality and capacity to stock the fish in and may even start off their capture journey with some ice. However, the hygienic conditions of the boxes vary and are usually substandard. Likewise, the thermal properties of these boxes are minimal, and ice rarely lasts for the entire capture).

¹³ Hurley, M., & Manel, C. (2015). Coordination, Development and Governance of Senegal Small-Scale Fisheries. Interactive Governance for Small-Scale Fisheries, 649 pp.

Landing: During the offloading process from the pirogues, the sardinella may or may not be transferred to plastic crates. If the catch is to be transported (by truck) to a far-off processing site or point of sale, crates are used to load the fish onto the trucks. These crates are rarely if ever cleaned between catches. If the destination is a nearby processing site, the sardinella catch might be directly landed on the sand and remain there, exposed to sun, heat and insects, until collected.

Local Transport: Sardinella is frequently transported to the processing site by horse cart, again exposed to sun, heat and insects.

Processing: Once at the processing site, sardinella undergo different treatment processes depending on the intended final product. Methods include fermentation in brine, braising, salting or smoking, or a combination of any of these methods. Specific food safety concerns at this stage are:

Hygienic conditions: With a little to no supply of safe water, maintaining hygiene is extremely difficult. Clean functional toilets are often not available. The actual fish processing facilities also exhibit a variable range of unhygienic conditions, such as unclean work surfaces, unsanitary cutting tools, dirt floors, unsheltered workspaces open to the elements, lack of running water, and minimal to no WASH facilities.

Chemical contamination: Traditional stoves used to braise and smoke fish are very basic and are not designed to prevent or limit the synthesis of carcinogenic PAHs. Specifically, the smoke generation temperature cannot be controlled. As a result, the final product can have a dangerously high PAH content. Smoked sardinella in nearby Ghana was estimated to have up to 10 times the maximum permitted levels of PAHs allowed by EU legislation.¹⁴



Sardinella crates being loaded into a truck in Joal. Photo by Juan Vilata-Simon

Inter-regional transport: From the coastal landing and processing sites, fish – both smoked or dried and raw – moves inland to both national and neighboring country markets. Many Senegalese consumers deem salted and smoked fish resistant to spoilage and therefore safe – but as seen from research on smoking and drying practices, this is highly uncertain. There is a robust trade of raw frozen fish (sardinella, mackerel and other species) to and from Senegal and neighboring countries, transported with little to no temperature control.

Recommendations and Next Steps

Reducing the presence of contaminants and pathogens in fish that in turn pose a threat to human health requires a focus on the dual challenges of maintaining cleanliness and product temperature throughout the supply chain. The greatest risk comes from two sources in the artisanal fisheries sector: bacterial pathogens and *polycyclic aromatic hydrocarbons* (PAHs). These threats can be mitigated by introducing food safety technologies and standard handling practices, but to be adopted and sustained by food

¹⁴ Beran, K. (2018). "Value Chain Improvements in Small-Scale Fisheries: Case Studies from West Africa (2018). Open Access Dissertations. Paper 785. Sustainable Fisheries Management Project (SFMP). 224 pp

businesses, they must make economic sense – profit. Testing *how* this can be done is the next important step for BD4FS in Senegal. Potential actions include:

Determining return on investment to mitigating against bacterial contaminants and biohazards: Key actors must implement sanitation measures along the supply chain, from capture through retail. BD4FS will seek ways to enlist and catalyze commitment from these actors to vigilantly adhere to food safety protocols onboard fishing vessels, at landing sites, at the fish buyers’ dock stations, during transport, and at traditional open markets.

In the case of PAHs, this hazard is almost exclusively concentrated at one node of the supply chain: the traditional fish smoking process. PAH mitigation can be addressed by motivating businesses to adopt handling guidelines at processing sites and by fostering the use of smoking stove models that minimize formation of PAHs. However, to be successful, raising consumer awareness about this threat and how to distinguish “safe” from “unsafe” smoked product should be part of this overall approach.

Promoting an evidence-based “culture of food safety”: Businesses that work with BD4FS to improve food safety must also be supported in “branding” their better product in the marketplace. Claims of food safety must be backed up with evidence. BD4FS will work with local research institutions and food testing labs to measure the presence of hazardous elements in fish. Using this information, businesses can claim a better product, consumers can have better choices and this supply-demand effect will help promote a “culture of food safety” that can influence consumer choices in other food products, as well.

Business-led standards and certification: Government has an important role to play in setting and enforcing food safety standards and certification programs. In many countries, however, the cost of establishing and effectively policing these standards is overshadowed by higher priorities demanding the



Lampoul landing site. Photo by Juan Vilata-Simon

use of scarce public resources. International certification standards do exist in Senegal, but primarily to serve export markets. In conducting the FSSA, the BD4FS team recognized that jumping to an international standard in supply chains serving domestic markets is not practical in most cases. Our approach, therefore, will be to work with businesses, business associations, food research institutes and consumer groups to identify measurable standards that supply chain actors can adopt that will make a difference for consumers choosing foods at the marketplace. We are preparing to launch a series of

brainstorming exercises with small and growing food businesses in Senegal that handle artisanal fish and other perishable products to better understand their perceptions of, attitudes towards, and perceived value of following standards in their business, and to explore what improvements they would be willing to make, at what cost, and their expected ROI.

Business financing and investment capital: Like most businesses around the globe, small and growing food businesses in Senegal, whether working in fisheries or other sectors, need capital to fund operations as well as investing for growth. FES is undertaking a financial landscape analysis in Senegal to assess constraints to accessing financing, articulate what types of financial and potentially non-financial services are most needed by various types of supply chain actors, and identify what financial institutions in Senegal

may be interested in partnering with BD4FS to make capital available. FES is also in discussions with impact investor groups and fund management partners to support development of a “Food Safety Accelerator and Fund” that would focus on investing in services – such as cold chain logistics, refrigerated transport – to reduce loss and contamination of perishable foods like fish.

Abbreviations

BD4FS	Business Drivers for Food Safety
COMFISH	USAID-Funded Collaborative Management for a Sustainable Fisheries Future Project
CONIPAS	Conseil national interprofessionnel de la pêche artisanale au Sénégal
CLPA	Conseil Local de Pêche Artisanale
CNPS	National Collective of the Artisanal Fishermen of Senegal
CRODT	Centre de Recherche Océanographique de Dakar-Thiaroye (Senegal)
DPM	Direction des Pêches Maritimes (Senegal)
EEZ	Exclusive economic zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FENAGIE-PECHE	National Federation of Fish Traders of Senegal
FENAMS	National Federation of Senegalese vessel owners
FENATRAMS	National Federation of Women Fish Processors of Senegal
FSSA	Food Safety Situational Analysis
GAIPES	Senegalese Ship-owners and Industrialists Association
GDP	Gross domestic product
HDI	Human Development Index
ILRI	International Livestock Research Institute
ISRA	Institut Sénégalais de Recherches Agricoles
IUU	Illegal, unreported and unregulated (fisheries)
JICA	Japan International Cooperation Agency
MCS	Monitoring, control and surveillance
OECD	Organization for Economic Co-operation and Development
UPAMES	Union of Senegalese Fishers and Exporters
USAID	United States Agency for International Development
USD	United States dollar
VCA	Value chain analysis

Annex I: Classification of health hazards by level of risk and potential action

This assessment classifies health hazards associated with seafood by three criteria: ease of detection, level of risk to the population, and feasibility of reducing the incidence. Each criterion is in turn categorized using the following scale: (1) low/easy (2), medium and (3) high/difficult.

Hazard	Occurrence (pre- or post-processing)	Detection	Risk level to the population	Implementation potential
Bacteria	both	1	2	2
Viruses	both	3	2	2
Parasites	Pre-	1	2	1
Heavy metals	Pre- ¹	3	3	na ²
Microplastics	Pre-	2	2	na ²
Histamine	both	1	1	2
Biotoxins	Pre-	3	3	3
POPs, PCBs, OCPs, PBDEs	both	2	3	3
PAHs	both (mostly post-)	2	3	1

¹Heavy metals are already embedded in the seafood tissues and cannot be eliminated by processing.

²Limiting consumption of the species found to have higher levels of heavy metals or microplastics is the only implementable action.

Annex II: Fishery policy and management structures

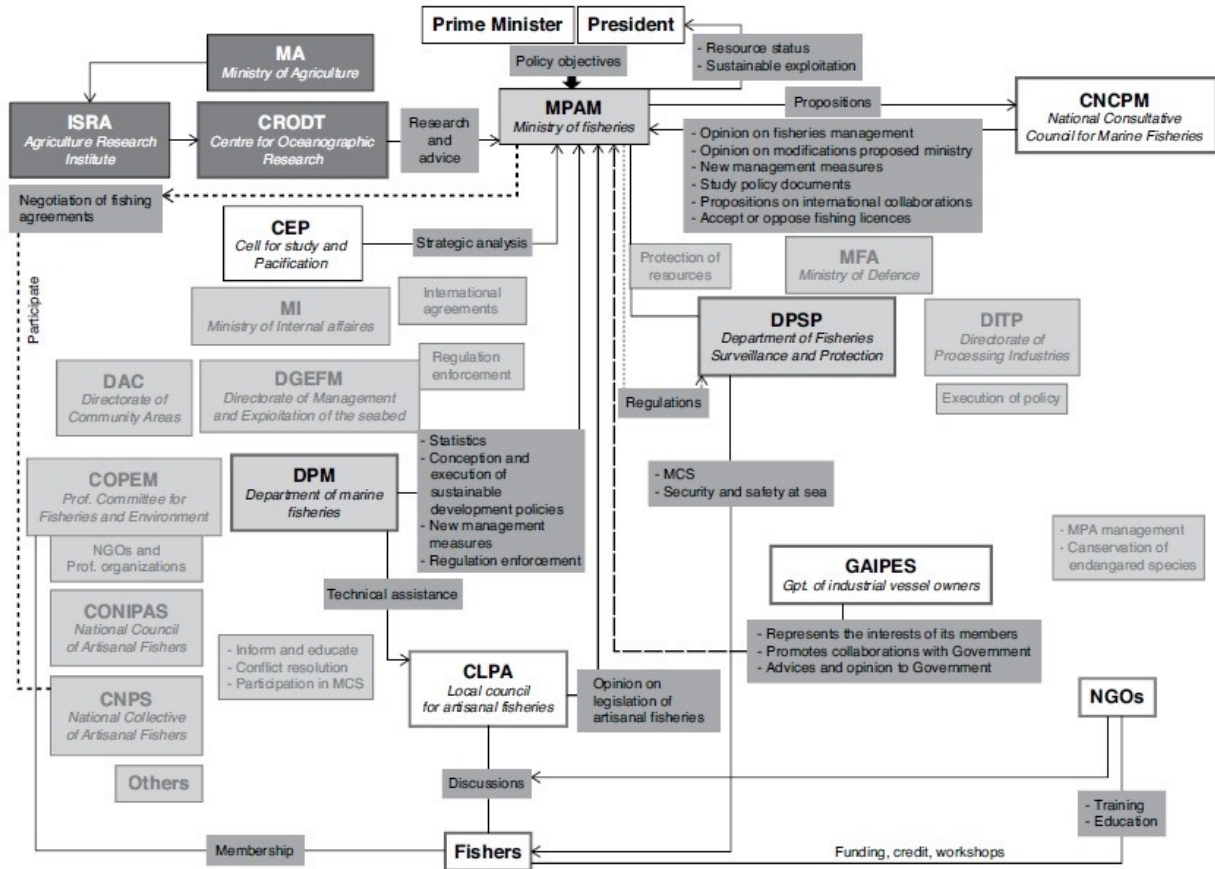


Diagram of the main institutions governing the fisheries in Senegal. (Source: Belhabib et al. 2017)

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Organizations and individuals consulted during the FSSA

<i>Type of organization/business</i>	<i>Number</i>	<i>Individual/expertise</i>	<i>Number</i>
Fish processor associations	4	Supermarket and restaurant procurement	4
Seafood processing & export	2	International organizations & universities	4
National food safety institutions	3	National subject matter experts	10
National associations & federations	6	Private sector entrepreneurs	7
Donors	2	Public sector	5