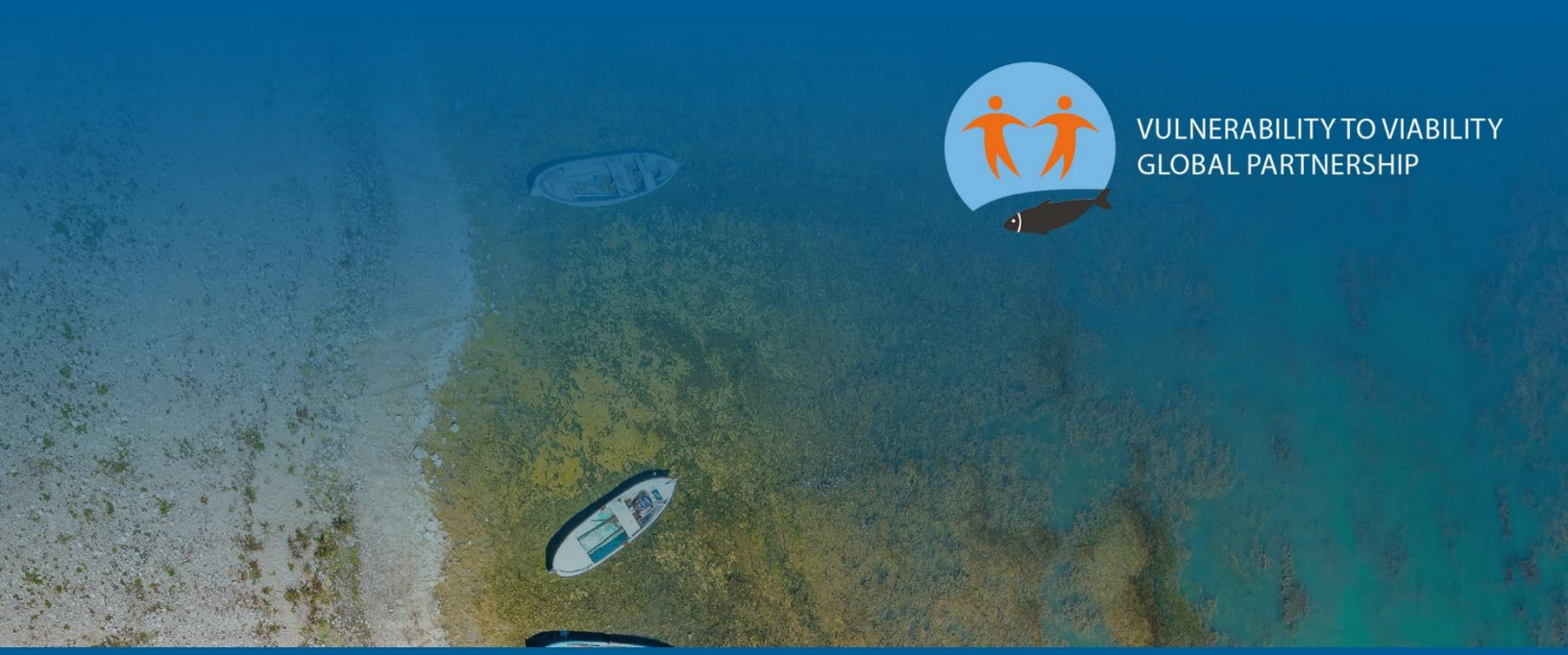

VULNERABILITY TO VIABILITY
GLOBAL PARTNERSHIP

A Situational Analysis of Small-Scale Fisheries in Senegal: From Vulnerability to Viability

Challenges and Opportunities for Fisheries Governance

V2V Working Paper No. 2022-2

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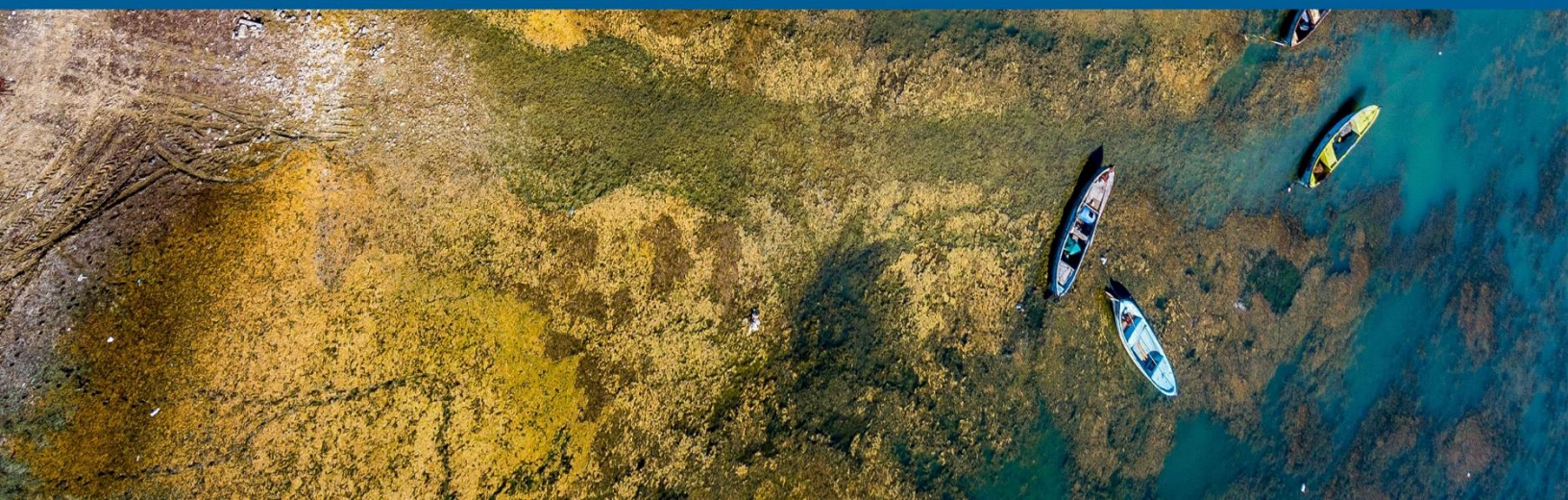
January 2022



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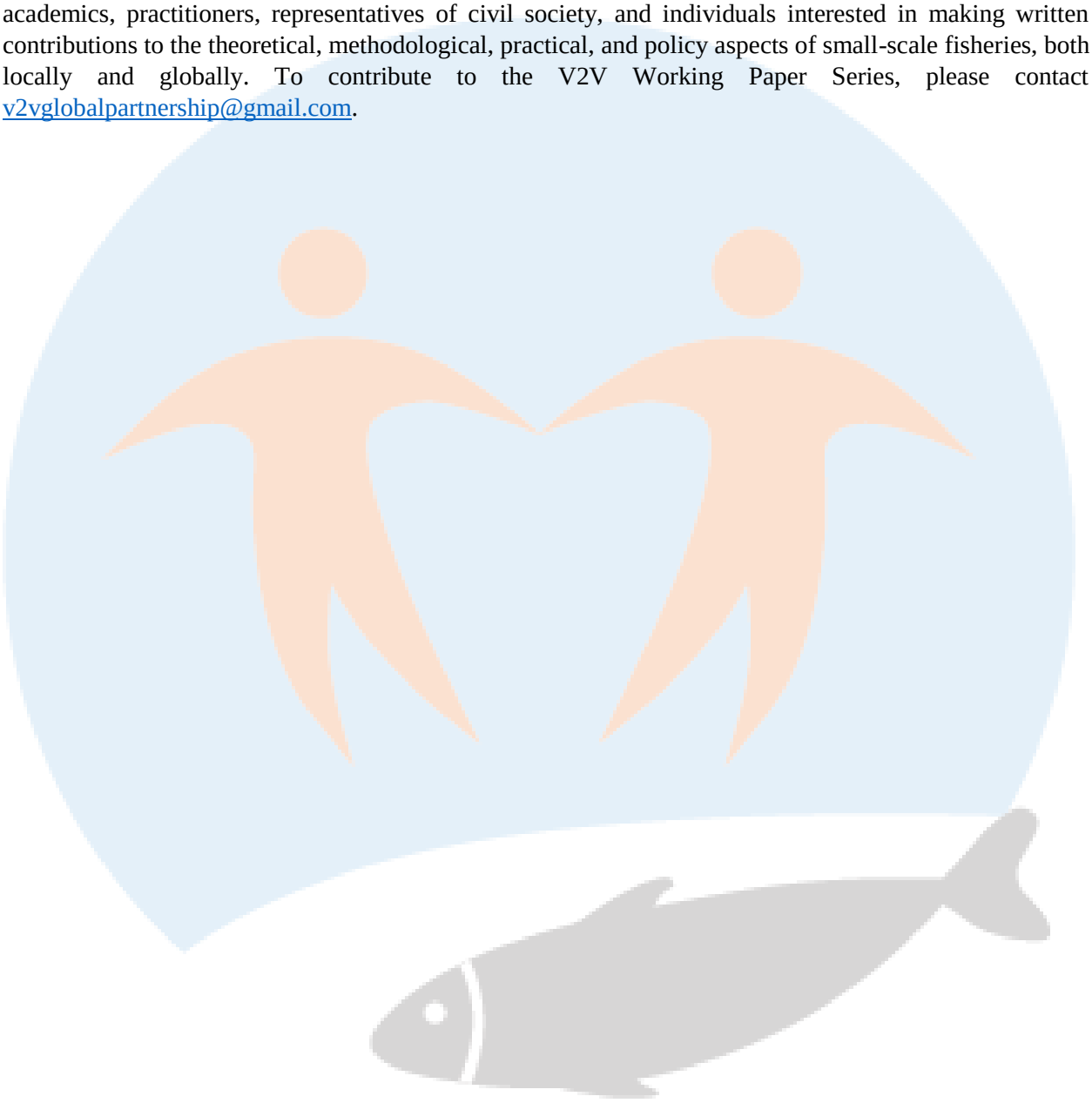
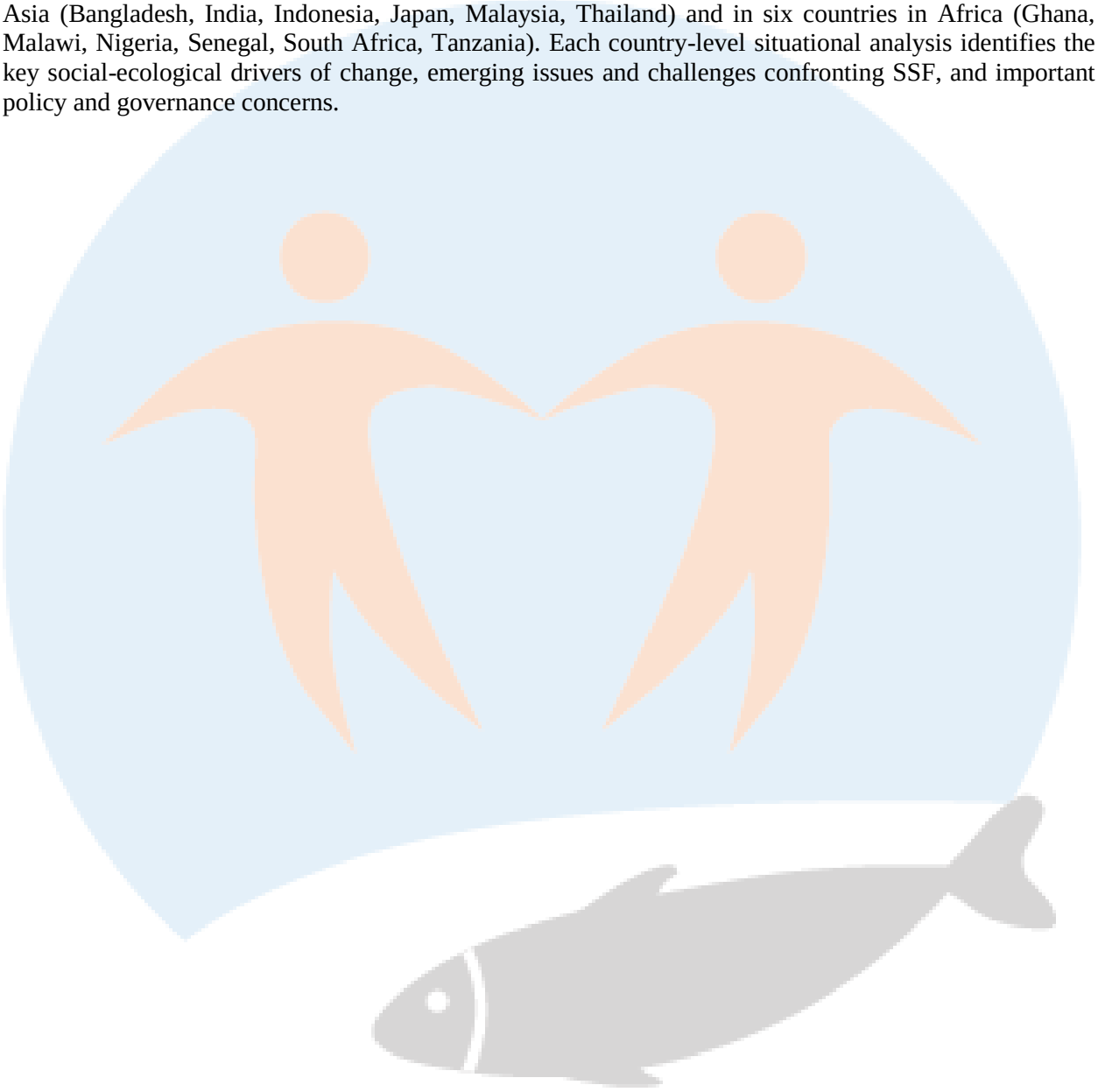


A V2V Situational Analysis of Small-Scale Fisheries

Small-scale fisheries (SSF) are an important economic resource, both at the local and global level; their depletion has ramifications on fundamental aspects of life, spanning from food security to society's wellbeing and culture. On the global scale, SSF provide food security and a source of livelihoods and income for more than 100 million people. The objective of the V2V Situational Analysis is to build a global perspective on key vulnerabilities and opportunities associated with SSF viability across six countries in Asia (Bangladesh, India, Indonesia, Japan, Malaysia, Thailand) and in six countries in Africa (Ghana, Malawi, Nigeria, Senegal, South Africa, Tanzania). Each country-level situational analysis identifies the key social-ecological drivers of change, emerging issues and challenges confronting SSF, and important policy and governance concerns.



IN MEMORIAM

Professor Fatou Gueye Lefèvre who was the Country Coordinator for the V2V Global Partnership Project in Senegal passed away on October 28th, 2021. UCAD and Senegal have lost one of their greatest servants. Prof. Fatou became the first female economics professor in UCAD since its inception in 1957.

She obtained her doctorate (PhD) in economics in 2012 from the Interuniversity Postgraduate Program (NPTCI) at UCAD. She was Heading the Development Policy Analysis Laboratory (LAPD) at UCAD and had actively participated and carried out research works on climate change, informal sector and various other development topics in West and Central Africa.

She invested so much effort into the success of the V2V Global Partnership Project in Senegal.

We all pray that her soul rests in peace and the Almighty Allah (SWT) grant her Paradise (Jannah Firdaws); May also Allah complete and accompany all the projects she had for her children and fill them with His blessings.

Thank you dear beloved Professor for your advice, guidance and positive impact on our career. We have understood your ambitions for us and will continue your work with the help of the Almighty. Thank you for the passion to research that you have transmitted to us. Your rigor and high sense of work well done will be missed forever.

Rest in peace dear Director.

Table of Contents

A Situational Analysis of Small-Scale Fisheries in Senegal: From Vulnerability to Viability - Challenges and opportunities for fisheries governance

Ahmadou Aly Mbaye[1] ● Fatou Gueye Lefèvre[1] ● Alassane Sarr[2] ● Clement Sambou[2] ● Adama Gueye[1] ● Fama Gueye[1] ● Khady Yama Sarr[1]* ● Afful Chineboaba Araba[1] ● Cheikh Amadou Bamba Gaye[2] ● Mariama Dieng[1]

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1. Introduction

Small-scale fishing (SSF) in Senegal is practiced by several fishing communities who use more than twenty fishing techniques with strategies that vary seasonally according to biological and socio-economic factors. The Senegalese fleet of pirogues is by far the largest in the sub-region. SSF remain the prerogative of the Senegalese. In Senegal, SSF is the main component of fishing activities, accounting for 81.6% of landings in 2018. SSF production in 2018 was 398,343 tonnes with a commercial value of FCFA 178,424,100, compared to 394,036 tonnes with a commercial value of FCFA 140,089,428 in 2017. This scenario shows an increase in volume and value of 1% and 21% respectively (DPM, 2020).

In Senegal, SSF is an activity that has an ethnic, or even family, basis. In 2018, it was practiced by an average of 70,041 fishers with approximately 11,912 active fishing units, more than 90% of which were motorized. In 2018, the number of fishers estimated at 70,041, decreased by 1,490 fishers compared to 2017 (DPM, 2018). Downstream fishing activities supported by a range of actors contribute to the employment, food security and well-being of thousands of people. Women play a crucial role in this group because by processing the raw material, they help to create added value, mitigate post-capture loss and provide the populations of Senegal and the West African region with the most affordable animal protein (Mbaye, 2005).

1.1 Small-scale fisheries governance in Senegal

Several actors are involved in the governance of SSF in Senegal. These actors include international groups such as NGOs, government institutions, decentralized institutions, professional organizations and local stakeholders. The fact that many entities interplay, makes fisheries governance more difficult and can jeopardize their management. This is exacerbated by the gradual disengagement of the state from the management of fisheries resources in favor of local communities. Indeed, the lack or insufficiency of human, material and financial resources makes local governance of SSF difficult. Senegalese authorities have initiated a fisheries management policy aimed at reducing pressure on exploited stocks, with a view to better integrate fisheries policies into national policies. This has finally allowed to prioritize the small-scale fishing industry and its contributions to national economy in terms of income, food security and safety (Niang, 2011). The involvement of fisheries stakeholders in decision-making as well as the various measures above, contribute to the transition towards sustainable fisheries.

In order to improve the governance of SSF, strategies and actions have been undertaken by the Senegalese state in recent years. These include:

- The elaboration of a sectoral policy letter for the development of fisheries and aquaculture (LPSDPA); though implementation strategies still need work;
- The revision of the Maritime Fishing Code formulated in 2015 to promote responsible and sustainable fishing;
- The institutionalization of local Small-Scale Fishing Councils (CLPA) as local governance and co-management bodies to promote capacity building of local actors and their involvement in the decision-making process;
- Introduction of a Small-Scale Fishing license and registration of pirogues to end the regime of open access to resources.

It should be noted that there is a considerable gap in the flow of information between institutions and stakeholders on initiatives, measures, projects and/or programs related to the extension of the FAO guidelines on SSF, as the institutional actors behind these initiatives still seem quite detached from the realities experienced by fishers (Cissé, 2020).

1.1.1 Policy innovations

Despite challenges, the government of Senegal has implemented recent innovations in the policy system, of which we highlight two as described below:

- *The Implementation of an Early Warning System (SAP)*

The USAID - ComFish project in collaboration with ANACIM has supported the implementation, since 2015, of a platform for the transmission of meteorological information to SSF actors, commonly known as the Early Warning System (EWS). This system is reinforced by USAID through the Climate Information Services Project to Increase Resilience and Productivity in Senegal (USAID/CINSERE). The SAP broadcasts SMS alerts received directly by the recipients' phones and used by the committees at the landing sites to green flag (safe sea), yellow flag (prudence) or red flag (dangerous sea, no exit) drapes. Local radio is also used to broadcast alerts (MPEM, 2018).

- *The project for the geolocation of small-scale fishing boats (in test phase)*

The Directorate of Fisheries Protection and Monitoring (DPSP) has undertaken a geolocation program for SSF vessels with the help of fishing stakeholders as well as technical partners. Four geolocation platforms are currently being tested with a total of 274 beacons (ANSD, 2020). These include the IUCN on the Cayar, Mbour, Joal and Yoff sites with a total of 33 beacons, the AGILTRACK VMS with 140 beacons and the EXACTEARTH in with 98 beacons, security and technological monitoring (SST) with three geolocated satellite phones. In addition, a study is underway within the framework of a project called "GAAL"[1] with the help of French experts for the development of a prototype of a beacon adapted to Senegalese SSF.

1.1.2 Actors, fishing methods, their evolution and stakeholders in the value chain

The different activities in the chain are capture fisheries, product processing, transport and freight. The most commonly used means of transport are pirogues, cars, carts, motorbikes and bicycles. SSF is organized

[1] GALL is the meaning of 'pirogue' in Wolof, one of the six national languages of Senegal. https://jangileen.kalam-alami.net/dictionary/word/wo/gaal

in the form of micro, or even nano-enterprises, in which the artisanal pirogue is the main means of production. Fishmongers are responsible for marketing fish products. In most cases, they are the main lenders of artisanal fishers.

Freight transport is an occupation dominated by men (50.60%), as well as capture fisheries and fish trade. Women are more likely found in fish processing (59.2%), with also oyster farming and shellfish harvesting. Women are the main actors in the artisanal fish processing sector in fishing areas such as Saint-Louis, Mbour, Joal-Fadiouth, Kayar and the Saloum Islands (REPAO, 2018). They have more flexibility in terms of adaptation than other actors in the value chain. The technology employed and management capacities have evolved considerably over time. For instance, where they used to sell product in baskets, women now sell them by weight; which allows to multiply the value of sale. Also, while the waste generated by fish processing activities used to be recycled as cooking fuel, it is now sold to farmers.

Women's initiatives in terms of circular economy (transformation of waste from fish processing into energy) is a very important element in the resilience of women involved in fishing in Senegal. Thanks to their organization, they have already made many achievements. Some of them work in association, which allows them to maintain their place in the fish industry and resist competition from fishmongers. Furthermore, many of them are joining savings and credit mutuals. These mutuals allow them to have access to revolving credits and to a credit system that is much more flexible and better suited to their needs. They are also introduced to the importance of saving which generates greater autonomy. Thanks to their organizational efforts, many women have seen their financial situation improve. They manage to help with family expenses and better manage their household. Some have even acquired material goods such as work facilities or houses.

1.1.3 Conflicts between different fishing groups

Surveys carried out by Ka and Gueye (2020) reveal that conflicts are very recurrent in the fishery sector. Indeed, 75% of the fishers interviewed confirm this and identify causes such as, ignorance of the regulations, poor governance, destructive fishing practices, defiance of regulation in fishing zones, and conflicts between active and passive gear. Conflict between communities (Mbao and Ngaparou, St. Louis and Yarakh especially) are also widespread. There are also conflicts between fishers and gold miners in the fishing areas of Kédougou and Tambacounda regions. Antagonism is also present: between St. Louis fishers and the Mauritanian coast guard, between foreign pirate vessels and Senegalese fishers, and between migrant and local fishers. The recent clashes between fishers from St. Louis and those from Dakar (Yarakh) have further exposed the social tensions between the different fishing communities. Conflicts related to fishers' migration require an integrated approach and harmonized rules which must be initiated and applied by all the actors involved.

1.2 Environmental vulnerabilities in small-scale fisheries

1.2.1 Coastal erosion and its impacts

Coastal erosion is a global coastal phenomenon. With Climate change, an increase in coastal erosion has been observed at Joal-Fadiouth and Foundiougne (REPAO, 2018). The current speed of the advance of the sea is impressive (winter). Indeed, in a two-week's time, the distance between the coastline and the fishing wharf increased from 15-20 meters (Figure 1) to less than 5 meters (Figure 1).

Figure 1.

Photos showing coastal erosion in Senegal.

Note. Adapted from REPAO (2018).

In addition, there is a degradation of the coastal area in the commune of Diembéring, with negative impacts on coastal activities and infrastructure, such as loss of rice fields: 25% of households in Diembéring and Cabrousse report having lost rice plots due to the saltwater rising (Thior et al., 2020). Other instances of degradation include the destruction of whole houses at Palmarin and the flooding of the Tiawlène cemetery (Rufisque) in 2007, where the sea had washed away 120 graves and whole houses. The latter persists to this day as a serious threat.

1.2.2 Habitat degradation - mangroves

The recent evolution of marine ecosystems is characterized by a degradation of marine habitats and a decrease in mangrove areas. Recent studies have shown that the extent of the disappearance of mangrove ecosystem areas has been declining sharply since the 1980s in the Saloum Delta in Senegal. Thus, surveys on mangrove areas have highlighted an increase in the total area of mangrove in the Saloum Delta from 31751 in 1972 to 38322.81 ha in 2010 (REPAO, 2018). In general, climate change trends affect the evolution of the range of marine resources, migratory movements, abundance and specific interactions (REPAO, 2018).

1.2.3 Changes in species composition

According to the International Union for Conservation of Nature (IUCN) Red List there is no extinct species in Senegal. This being said, some species are considered rare or endangered. The displacement of certain ichthyological species such as *Dentex vulgaris valenciennes*, *Epinephelus aeneus*, *Esox lucius*, *Sparus aurata*, *Ephippion guttifer*, *Polydactylus quadrifilis*, *Pseudotolithus senegalensis*, *Argyrosomus regius*, Mugilidae, etc. The variation of the bathymetry is also responsible for the displacement of fish that cannot live in depths lesser than 6 meters such as in the estuary at the level of the “Langue de Barbary”. Finally, while there is no appearance of new species in St. Louis, some species such as the *Ephippion guttifer* have disappeared (REPAO, 2018).

2. Meaning and status of small-scale fisheries

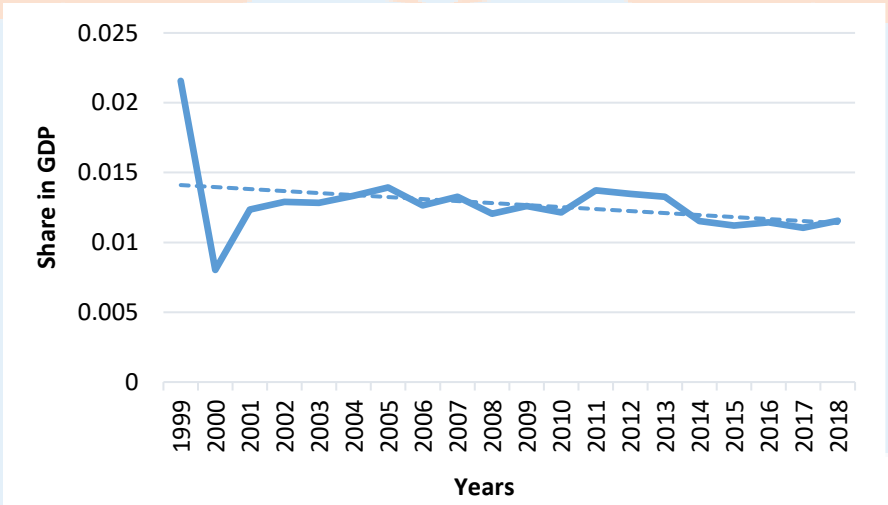
2.1 Small-scale fisheries contribution to Senegal

SSF contribute to national food security and the socio-economic stability of many of households by providing job opportunities for fishers, fishmongers, and processors. In addition, SSF contribute to many dynamics related to a range of activities, from porters, micro fishmongers, carters in the landing docks to retailers in markets (urban and rural) and diverse actors in the transportation of fishing resources. Thus, SSF has a great potential for providing jobs, which is often poorly assessed.

Fish from SSF represents 95% of the national market (MPEM, 2018) and it contributes to the food security of local populations by providing them more than 75% of daily animal protein needs (Le Roux, 2005). Since 2015, fish products have been the country's leading export revenue with 193.5 billion, 204.43 billion and 244.16 billion respectively between 2015 and 2017 (MPEM, 2018). The share of artisanal fisheries in Senegalese GDP has a fairly stable trend between 2001 and 2018. On average, the contribution of Small-Scale fishing to Senegal's GDP is 0.01341684 (1.34%) per year between 2001 and 2018.

Figure 2

SSF share in Senegalese's GDP from 1999 to 2018

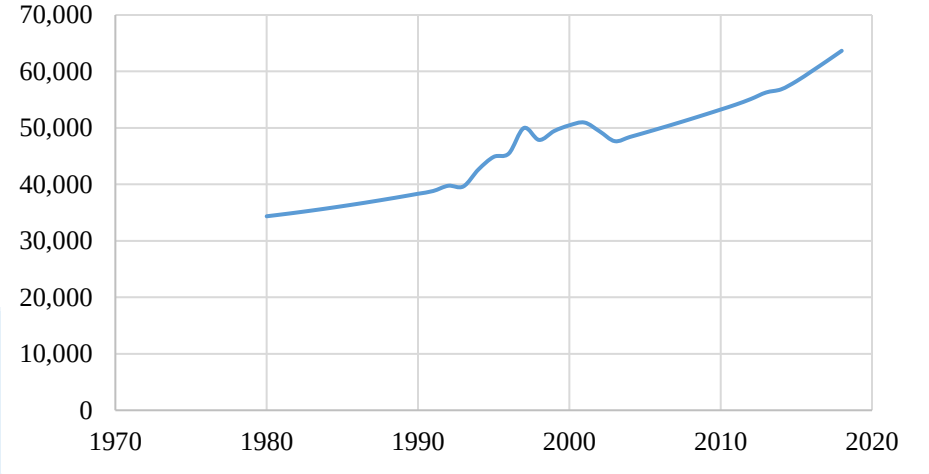


Note. Built from ANSD data (2019).

Regarding job opportunities, there is not specific data available to gauge how many or what kind of jobs are created by SSF. One published report tells us that "fishing occupies nearly 15% of the Senegalese active population, i.e., about 600,000 people" (Sall et al., 2006, p. 34). This information is too broad to be able to estimate the number of jobs by type of occupation, especially as the Senegalese population has grown over time (Sall et al., 2006). Total employment over the entire period is 1,817,047. On average, 46,591 jobs are created annually between 1980 and 2018.

Figure 3

Employment generated by Small-Scale Fishing in Senegal from 1980 to 2018



Note. Built from ANSD data (2019).

2.2 Small-scale fisheries profile in Senegal

In Senegal, the Minister of Fisheries and Maritime Economy defines SSF as fishing carried out with open vessels that use means of capture not mechanically operated and whose only means of conservation is ice or salt (MPEM, 2018). Senegalese SSF use a variety of fishing gear types, vessels and target species, as shown in tables 1-3. The total number of motorized pirogues was estimated at to be 11,5899 in 2019; compared to 10, 445 in 2018, an increase of 5%. For the other pirogues, the number was estimated at 1,262 in 2019, compared to 1,467 in 2018, a drop of 16% (MPEM, 2018). Vessel information is summarized in tables 4 and 5.

Table 1

Summary of small-scale fisheries profile in Senegal

Terms used in SSF	Gear types	Vessel types	Ecosystem types	Ecosystem detailed types
• Artisanal • Coastal • Inland • Small boat • Subsistence • Traditional	• Cast nets • Gillnets • Gleaning • Harpoons • Hooks and lines • Recreational fishing gears • Seine nets • Surrounding nets • Traps • Trawls • Gillnet anchored to the Surface • Gill net anchored to the bottom • encircling gill net • Surface drift gill net • Bottom drift gill net • Beach seine • Purse seine • Killi • Shrimp trawl • Fixed Shrimp Net • Hand-Fishing • Deep-sea diving	• Raft • Piroque • Wooden • Fiberglass	• Marine • Freshwater	• Archipelago • Beach • Coastal • Lake • Mangrove • Deep sea • Estuary • River

Table 2

Summary of gear type and target species

Gears type	Local name (wolof)	Target species
Cast nets	-	• *Mugil cephalus, Ethmalosa fimbriata, Tilapia sp*
Set Gillnets	Mbaal sër	• *Dasyatis spp, Synaptura spp, Cynoglossus spp, Psettodes belcheri, Mustellus mustellus, Pomadasys spp, Sphyraena spp, Galeoides decadactylus, Polydactylus quadrifilis, Pagrus spp, Pseudotolithus spp, Arius spp, Caranx spp, Epinephelus spp, Sardinella spp; Farfantepenaeus notialis, Palinurus spp, Cymbium spp, Murex spp, Sepia officinalis*
Bottoms drift Gillnets	Yolal	• *Sphyraena spp, Ariusspp, Pseudotolithus spp, Caranx spp, Pomadasys spp, Epinephelus spp, Mustelus mustelus, Mustelus mustelus, Diplodus spp, Lichia spp, Sphyraena spp*
Encircling gillnets	Saïma ou Saïna	• *Sardinella aurita, Sardinella maderensis, Ethmalosa fimbriata, Scomber colias, Caranx spp, Arius spp*
Gillnets	-	• *PseudotoZithus spp., les Arius spp., requins, barracudas, solea vulgaris, batoidea, , batoidea, tilapias, ethmaloses, barracuda, Euthynnus alleterratus, Scomberomorus tritor, Mugilidae, Polynemidae, Caranx spp., Pomadasys spp., Pseudotolithus spp.,*

		Tilapia spp., Arius spp, Ethmalosa fimbriata, Sardinella spp., Adus spp., Carur spp., Pseudotolithus spp., Sphyraena spp.
Harpoons	-	• *Large size fish*
Hooks and lines	-	• *EpinepheZus spp., Pomadasys spp., Caranx spp, Arius spp., Sphgraena spp., Epinephelus aeneus, Carcharhinus signatus, Polydactylus quadrifilis, Drepane afticana*
Surface Drift Gillnets	Félé Félé	• *Ethmalosa fimbriata, Mugil spp, Liza spp, Sardinella aurita, Sardinella maderensis, Trichiurus lepturus, Caranx spp, Euthynnus alleteratus, Sarda sarda, Trachurus spp, Caranx ronchus, Pseudotolithus spp, Arius spp*
Beach seine	Mbaal law	• *Mugil spp., Sphyraena spp., Cynoglossus spp, Scomberomorus tritor, Sarotherodon melanotheron heudelotii, Tilapia guineensis, Polydactylus quadrifilis, Drepane africana, Caranx spp, Arius spp, Sphyraena spp, Pseudotolithus spp, Cynoglossus spp, Synaptura spp, Pomadasys spp, Cymbium spp*
Purse seine	Fila tourné	• *Caranx spp, Ethmalosa fimbriata, Sardinella aurita, Sardinella maderensis, Trichiurus lepturus,Mugil spp, Euthynnus alleteratus, Sarda sarda, Arius spp, Argyrosoma regius Pomatomus saltatrix*
Castnets	Mbal sani	• *Mugil spp, Liza spp, Tilapia spp, Sarotherodon melanotheron heudelotii, Hemichromis spp*
Shrimp trawls	Drague Killi ou Mbal Xuss (chalut à pied)	• *Farfantepenaeus notialis*
Seine nets		• *Mugilidae, Sphyraenidae, Soleidae, Scombridae, Cichlidae, Polydactilus quadrifilis, Drepane africana, Garanx hippos, Ethmalosa fimbriata, Sphyraena spp., Arius spp., les Pseudotolithus spp., Drepane africana, Galeoïdes decadactylus*
Surrounding nets	-	• *Ethmalosa fmbriata et Sardinella spp., Arius spp., Caranx spp., Pseudotolithus spp., de Sphyraena spp*
Filet fixe à crevettes	Moudiass	• *Farfantepenaeus notialis*
Stake nets Lines (handlines, longlines)	-	• *Sphyraena spp, Arius spp, Epinephelus spp, Sepia officinalis, Octopus vulgaris, Loligo sp, Trichiurus lepturus, Lutjanus spp, Scorpaena spp, Pagrus spp, Pagrus spp, Dentex spp, Pomadasys spp, Polydactylus quadrifilis, Dasyatis spp, Xiphias gladius, Mycteroperca rubra, Latilus semifasfiatus*
Traps	Fiir	• *Palinurus spp, Sepia officinalis, Poissons, Octopus vulgaris, Callinectes spp, Farfantepenaeus notialis*
Trawls	-	• *Penaeus notialis, Pomadasys spp., Tilapia guineensis, Mugil spp., Sarotherodon r-nelanotheron heudelotii, Polydactylus quadriilis, Pseudotolithus spp., Ethmalosa firnbriata, Tilapia spp., Solea spp., Callinectes spp.*
Scuba diving	Nourou	• *Epinephelus spp, Lutjanus spp, Palinurus spp, Cymbium spp, Octopus vulgaris, Sepia officinalis, Perna perna*
Gleaning	-	• *Senilia senilis,Crassostrea gasar, Cymbium spp, Murex spp, Pugilina morio, Haliotis spp*

Note. Adapted from Bousso (1994).

Table 3

Total number of days fishing by gear group in 2019

Gear types	Number of days fishing by gear
Line pirogue voile	18 817
Line engine pirogue	445 223
Drag nets	348 055
Beach seines	11 775
Purse seines	70 693
Encircling gillnets	52 602
Others gear	125 795
Total	**1 072 960**

Note. Adapted from CRODT (2019).

Table 4

Number of pirogues in Senegal in 2019

Egions	Motorised pirogues	Other pirogues	Estimated number of fishers
Dakar	3 819	-	22 938
Thies	4 174	-	24 444
Saint-Louis	1 037	-	8 340
Ziguinchor	1 242	960	9 149
Fatick	1 158	135	8 666
Louga	118	-	541
Kaolack	42	167	1 290
Total	**11 589**	**1 262**	**75 369**
Reminder 2018	10 445	1 467	70 041
Evolution	**10%**	**-16%**	**7%**

Note. Adapted from Direction des Pêches Maritimes (2019).

Table 5

Crew according to the type of pirogue

Type of pirogue	Crew	Typical engine size
Pirogue named ‘’Dugout’’	10	
Pirogue named ‘’Ngueth’’	6 to 10	outboard engine 8 to 40 hp
Pirogue, quite large over 12 m	20	outboard engine 6 hp
Pirogue with an overall length of 10 to 12 m	6 to 10	
Pirogue, variable length 12 to 15 m,	8	without engine
Sea pirogue with spurs:	10 to 20	
Pirogue of 12 m (overall)	6 to 8	outboard engine 18 to 20 hp
Pirogue 8-12 m long	2 to 3	outboard engine 6 hp
small monoxyl pirogue (central float) and large monoxyl pirogue (shuttle pirogue)	2	
Pirogue from 12 to 15 m with spurs	7 to 8	
Pirogue of 14 to 16 m long	8	outboard engine 25 hp
pirogue with spurs of 13 m overall length	4 to 5	outboard engine 6to 18 hp

Note. Adapted from Seck (1980).

2.3 The relevant linkages between ecosystems and small-scale fisheries in Senegal

Senegal has very productive ecosystems, but this productivity is subject to significant variations linked to the phenomenon of upwelling. The upwelling of deep cold-water rich in mineral matter, caused by the cold current of Canaries linked to the maritime trade winds during the dry season (from November to June).

The marine ecosystem constituted by the Senegambian continental shelf is marked by a great diversity of habitats and fish species. This diversity results from the morphological and sedimentological characteristics of the continental shelf and slope, but also from the hydrological and dynamic characteristics of the water bodies (up-wells). With a long maritime coast of more than 700 km, Senegal has many coastal ecosystems marked by deltas and estuaries, rocky and sandy coasts and wetlands. The deltaic and estuarine areas (Saloum and Casamance) are characterized by mangroves, mosaics of sandy islands and lagoons (MEPN, 2010).

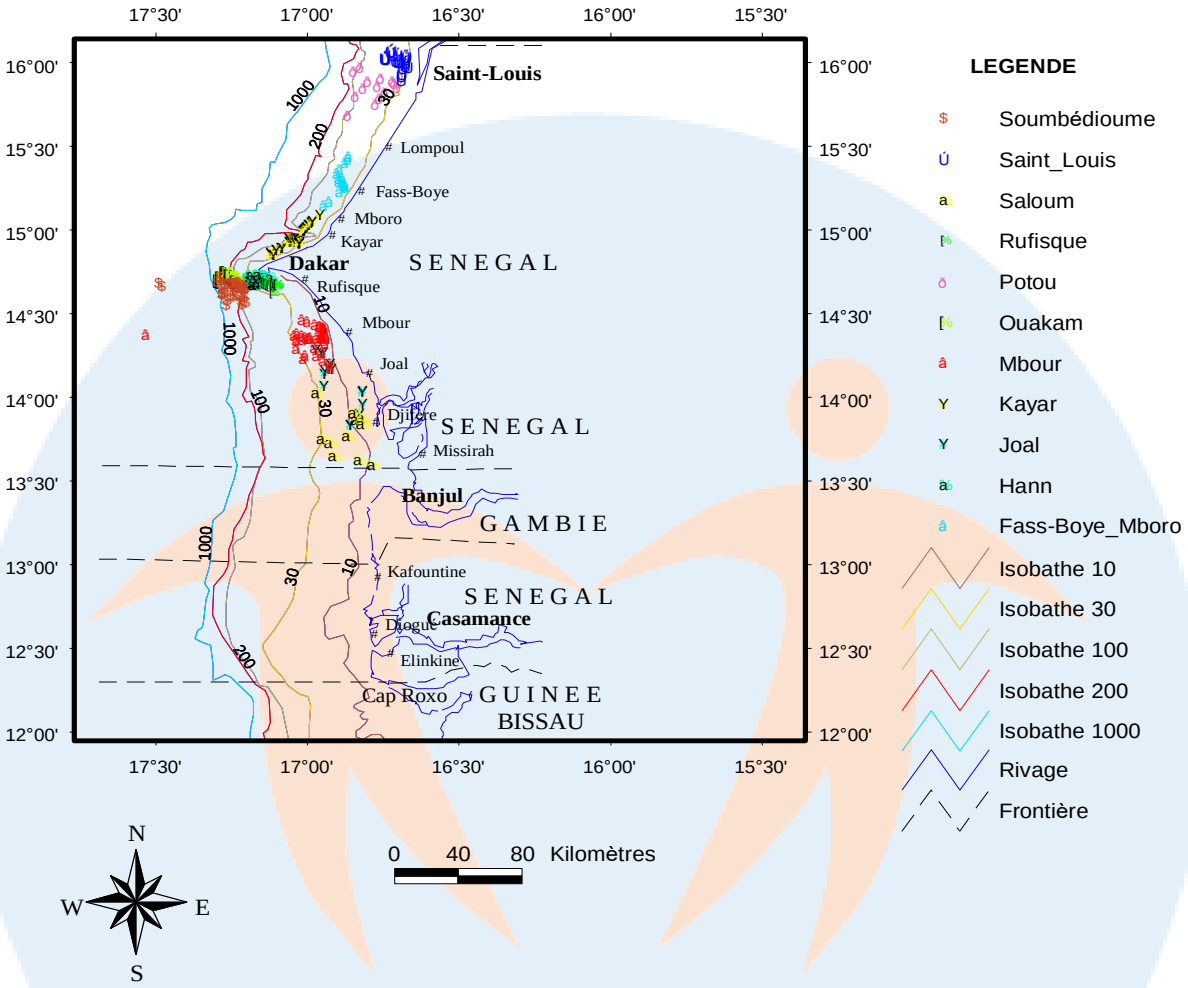
Mangroves occupy the downstream parts of estuaries, deltas and major river mouths. They develop in the tidal fluctuation zone and are constituted by six very characteristic species: *Rhizophora racemosa*, R. *harisonnii, R. mangle, Avicennia africana, Laguncularia racemosa* and *Conocarpus erectus*. These ecosystems contain a rich and varied fauna made up of migratory and sedentary species (mammals, fish, shrimps, crabs, oysters, shellfish, etc.). These are nursery areas of great economic importance. Beyond the deltas, the coasts are sandy or rocky (Cape Verde peninsula).

Senegal is under increasing national and international pressure regarding the preservation of its fishery resources, because the overexploitation of resources has a considerable impact on their biodiversity. In fact, it has recently been observed that certain Senegalese fish species such as Epinephelus aeneus (Thiof)[2] are becoming extinct. In addition, pollution, urbanization, destruction of vegetation and mining are increasing the phenomenon. Up to now, attempts by the fisheries administration have failed to reverse the trend of resource depletion. Faced with this situation, the Senegalese government wanted to react by emphasizing marine protected areas. Figures 4 shows the main areas used by SSF in Senegal.

[2] Senegalese name of Epinephelus aenus

Figure 4

Mapping of Small-Scale Fishing areas in Senegal



Note. Adapted from Mbaye et al. (2018).

3. Social-ecological changes and key drivers

Small Scale Fishing (SSF) in Senegal is affected by several physical and biological, economic, entropic and institutional factors. In this section, we provide information on key social-ecological changes and key drivers of change in respect to SSF vulnerabilities and viabilities in the context of Senegal.

3.1 Physical and biological factors

Berrit (1952) identifies two seasons in Senegal: the dry season with a trade wind regime (i.e., November-May) and the wet season with a monsoon regime (i.e., June-October). These two seasons justify the strong presence of winds and rain, which are the two most influential physical factors at sea. The trade winds play an important role in the process of water fertilization by causing the deep waters to rise. This phenomenon

is called 'upwelling'. While the humid monsoon favors abundant rainfall at sea and contributes to bringing warm water back to the coast. The rain, resulting from the monsoon, are at the origin of salt-freshwater interface which is a factor of high biological productivity at the level of the Senegalese coasts (Camara, 2008).

Vulnerabilities affecting the main physical factors of the ocean and other factors that, in turn, negatively affect SSF include climate change, marine pressure and coastal erosion. Climate change causes coastal erosion and sea level rise. Added to this is the increase in the frequency of dry hazes which affects sedimentation in certain areas of the Saloum estuary (Barusseau et al., 1983). Climate change is also a main cause of drought that drastically affects fishery resources in inland areas. Furthermore, the coastal zone, which already has a very unstable coastline, suffers from marine and wind erosion, as well as from erosion caused by the development of coastal buildings.

SSF is currently facing an increase in maritime pressure which is at the origin of the scarcity of fish products. In addition to the strong maritime pressure, other factors are at the origin of this shortage, including illegal, unreported and unregulated fishing conducted by foreign vessels with foreign fishing licenses (Ka & Gueye, 2020). In the Saloum area, the effects of climate change are at the origin of the transit of large fish to the area and by extension the displacement of fishers (Camara, 2008).

Mangroves played an important role in regulating other ecosystems. In addition to the protection of coastal areas against erosion, mangroves constitute a nursing and shelter habitat for some species (such as crustaceans and other small fish). Currently, a strong degradation of mangroves is noted in Senegal. This is mainly due to hydro-agricultural developments, drought, overexploitation of mangrove resources and salt extraction.

3.2 Economic factors

One economic factor with a significant interplay with SSF is exports. With the devaluation of CFA in 1994, the fish exports have increased, leading to the drastic decline in the level of local fish consumption. This has changed the nature of the catch in SSF. There has been an increase in the catches of demersal species (demersal species are destined for the more remunerative European market) with high added value to the detriment of pelagic species. These exports are thus at the origin of a fishing pressure directed towards species, such as sole, lobster, cuttlefish, octopus and shrimp. The establishment of factories on the small coast has also changed the nature of the catch. Indeed, industrial processing targets demersal species[3]. Between June and September, fishers on the short coast favor cuttlefish and octopus for the factories (Deme & Kebe, 2000). There are more of these species during this period.

From an employment point of view, SSF help to reduce unemployment, especially among women. Women in Senegal are employed in artisanal processing. Products from processed species are: smoked and dried fish, dried cymbium, dried oysters and arches, etc..Artisanal processing plays a stabilizing role for the fresh produce market by accommodating overproduction (Deme & Kebe, 2000). The prominence of SSF has increased its need for financial resources. However, the skepticism of commercial banks towards SSF has led to the development of an informal credit sector for fisheries, which is not sufficiently developed to meet SSF needs.

[3] Demersal : Epinephelus aeneus, Panaeus, Epinephelus, Spondyliosoma cantharus, etc.

3.3 Social and cultural factors

In Senegal coastal areas are heavily populated, especially the cities of Dakar and Saint Louis. Cayar, Lompoul and Fasse Boye are home to 75% to 80% of the nation's fishers. At the same time, the population of the coastal villages continues to grow. This is the case for the villages of Cambérène, Niangal, Yène and Toubab Dialao. This population density of the coastal areas contributes to coastal erosion and to the degradation of mangroves through overexploitation of resources.

Ka and Gueye (2020) show a decline in catches between 2006 and 2019 caused by overfishing and the use of inappropriate techniques and tools due to the presence of fishing vessels and industrial fishing. This overexploitation of marine resources is a major reason for the decline in catches and the disappearance of species. In addition to the decline in catches, the issue of disposal arises in some areas (St Louis, Cayar) with a lack of infrastructure such as loading docks and cool storage facilities.

3.4 Institutional factors

Since the 1990s, fishing has become a regulated activity. Fisheries regulations cover several aspects, the most important of which is the prohibition (size regulation) to catch small fish without market value and the requirement to return small fish to the sea. These measures are common among several coastal countries, including those in West Africa. In order to develop SSF, the government has launched several programs. These programs concern in particular the motorization of pirogues as well as the modernization of pirogues and of fishing techniques. They also involve the distribution of subsidies and credits at preferential rates. Fishing thus experienced enormous technological progress with the motorization and the introduction of the purse seine.

The motorization of pirogues began in the 1950s, but during the 1970s it developed with the introduction of the Yamaha engine, distributed first by the 'Centre d'Assistance à la Motorisation des Pirogues (CAMP)' in 1972, then by the 'Centre d'Aide à la Pêche Artisanale (CAPA)'. Fishing thus experienced enormous technological progress with the motorization and the introduction of the purse seine; however, with a resultant decline in profitability of certain species and the overexploitation. Moreover, rope boats have not been able to reach their profitability threshold, and the lack of means for fishers to renew spare parts and their engines (Ka & Gueye, 2020).

With regards to the delimitation of fishing zones, several laws have been established from the Geneva Convention of 1960 to the United Nations Convention of 1985 setting the limits of the different fishing zones in Senegal. These laws concerned sardine boats and trawlers. The last law of 85-14 sets the fishing zone at 12 nautical miles from the baseline and introduced fishing licenses. In addition, the UN Convention is the origin of the Exclusive Economic Zone (EEZ) which authorizes Senegal 200,000 boats beyond their territorial zone.

While the government was successful in implementing several measures for technological innovation, some shortcomings may still be noted. These include three main topics. First, the failure to comply with safety measures, in particular the wearing of lifejackets. The article 15 of Law 87/27 on the Maritime Fisheries Code made the wearing of lifejackets an obligation. In case of non-compliance a fine of 20,000 CFA francs is imposed. The vast majority of fishers do not respect this measure. Moreover, pirogue leaders and owners are not required to obligate their fishers to follow this rule. The reasons given by the fishers are of a traditional nature, that is, the wearing of lifejackets presages accidents or testifies to the poor performance of the fisher; of a pecuniary nature, e.g., price too high; among other reasons, e.g., uncomfortable with the maneuvers of the net.

A major source of vulnerability in Senegal SSF include the fact that policies do not properly address the need to protect the coastline. With climate change, coastal erosion reduces space for pirogues, posing logistical problems for small-scale fishers. In Yoff, Rufisque and Bargny, former traditional Lébous villages and fishing harbors, a significant decline in the coastline is observed. The occupation of the coastline by tourist establishments violates Law No. 76-66 of 2 July 1976 on the maritime public domain. Due to the abusive use of Law 19 of the State Domain Code allowing land to be declassified in the public domain, tourist activity has been able to exclude the activity of small-scale fishing in several areas.

Finally, SSF receive inadequate funding. The increase in the cost of SSF inputs reduces the self-financing capacities of fishers. Thus, the use of external credit has become essential. However, there is unwillingness from funding institutions and weak support from the state (Weissenberger et al., 2016).

3.5 SSF affected by covid-19 pandemic

Covid-19 has disrupted all economic sectors, including the fishing industry. SSF depend on the free movement of fishers, access to landing centers, and on the fluidity of inter-regional, inter-territorial and airport transport systems. To this end, the most visible impact of the pandemic on SSF is the disruption of fishing hours associated with the limitation of production areas and the drop in production during the high season (Camara, 2008). Measures have been taken against the spread of Covid-19 on Senegalese territory, including curfews. This limits fishing hours, access to areas of abundance and partial closures of docks and landing areas. The Decree No. 2020-830 of March 23, 2020 limits the opening of the Mbour dock to 3 days (Monday, Wednesday and Friday) between 6 and 18 hours.

Senegal's response to Covid-19 coincided with its high season of fishing activity, which affected the level of production and quality of fish product. Limiting fishing hours and closing docks make access to fishing areas difficult due to lack of time, and result in the loss of surpluses intended for processing. With regard to fish wholesaling, there is a slowdown in the flow of products. And finally, the export circuit was frozen following the closure of borders (Ka & Gueye, 2020). However, this drop-in activity caused by the pandemic will be conducive to the reproduction of species.

The decrease in fishing pressure during the pandemic period can have positive effects on resources and the environment. For example, temporarily halting fishing can reduce the negative effects of fishing vessels on the ecosystem by putting an end to seabed trawling and noise pollution. Moreover, a drop in fish production may also reduce mangrove deforestation as a source of wood used for smoking fish.

4. Emerging Issues in small-scale fisheries in Senegal

4.1 Current trends in climate change

4.1.1 Evolution of temperature

Temperatures evolved in an increasing trend between 1980 and 2015 (Bah, 2016). In the long term, temperatures will increase on average by 0.24°C globally (IPCC, 2014). The change in the average temperature at the earth's surface for the period 2016-2035, relative to that of 1986-2005, will be between 0.3 ° C and 0.7 ° C (IPCC, 2014). This will lead to an increase in temperature of the oceans which will be more pronounced near the surface. The most significant warming will occur in the surface ocean of the tropics and subtropics of the northern hemisphere. This warming will negatively affect fishery resources, in particular pelagic resources.

An increase in water temperature could directly affect fish and marine invertebrate populations. Indeed, an increase in water temperature affects the metabolism of aquatic animals and the oxygen content of the water. Fish and marine invertebrates thus respond directly to warmer water by moving to areas where temperatures are more in line with their needs. The migration of fish, particularly small pelagic fish, to other more suitable areas may result in a decrease in fishery resources in the Senegalese coast.

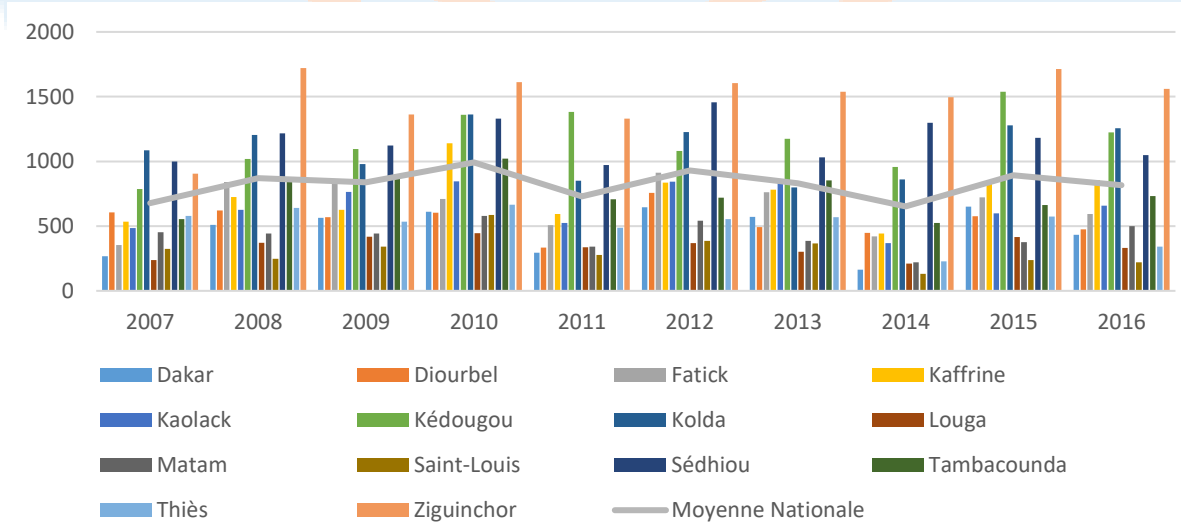
4.1.2. Evolution of rainfall

The evolution of rainfall (Figure 5) is characterized by interannual and intra-annual variability (Bah, 2016). The variations of the seasons are linked to climate. In Senegal, the dry seasons are getting longer. The average rainfall never exceeded 1000mm between 2007 and 2016. The rains are irregular. These rainfall irregularities are more prominent in the northern Senegal. There are more episodes of extreme precipitation (storms, floods). The number of floods has increased from one between 1990-2000, to six between 2000-2010 and continues to increase. Erratic precipitation negatively affects fish production. The magnitude of these effects depends on the agro-climatic zones.

Decreasing precipitation and the occurrence of increasingly powerful extreme events are impacting river flows, consequently marine habitats (FAO, 2018). Extreme precipitation events (e.g., storms) lead to rising waters and flooding. They cause the destruction of coastal land areas (e.g., beaches, landing areas), coastal infrastructure (e.g., roads, wharves, landing sites, processing units), fishing equipment (e.g., pirogues, gear) and lead to loss of human life. They can lead to displacements (e.g., migrations), resettlement of fishers in other sites or their reconversion towards other economic activities (e.g., transport, tourism).

Figure 5

Evolution of rainfall in Senegal (in different areas)



Note. Adapted from ANACIM, Senegal, 2017**.**

4.1.3. Other manifestations of climate change

Other manifestations of climate change are sea level rise and increasing river salinity. Indeed, between 1901 and 2010, the global average sea level rose by 0.03 m (from 0.17 to 0.21 m). Sea level rise leads to flooding in coastal urban areas. In Senegal, flooding due to sea level rise is common in Saint-Louis and Rufisque. This leads to increased salinity in coastal areas. Furthermore, it is revealed that since the 1950s, high salinity regions have become more saline (Gies et al., 2014). This ocean acidification has negative impacts on marine habitats. In Senegal, the decrease in mangrove areas is noted in the Saloum Delta (REPAO, 2018).

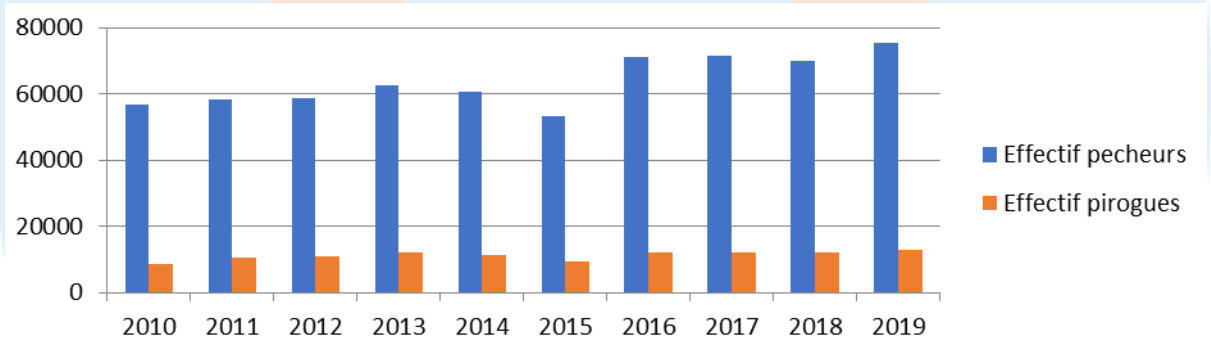
4.2 Recent evolution of small-scale fisheries

4.2.1 Evolution of fishing effort, catches and fish yields

Fishing effort is measured by the number of fishermen and the number of pirogues. The number of fishermen is on an upward trend between 2010 and 2019. While the number of pirogues is evolving in a stagnant trend (Figure 6).

Figure 6

Number of fishers and pirogues

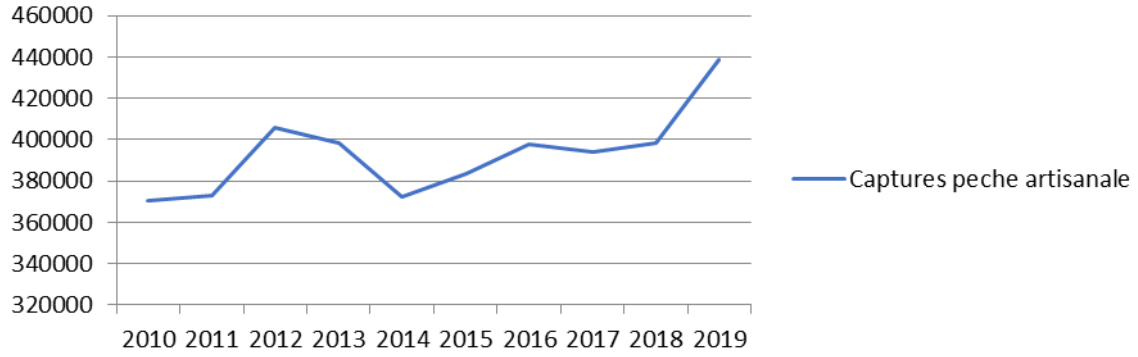


Note. Adapted from Data from DPM, Senegal (2020).

The catches of SSF fluctuate in an upward trend, as shown in Figure 7. They rose from 370448 tons in 2010 to 383222 tons in 2015 and will reach 438567 tons in 2019. SSF contributes around 90% of total landings.

Figure 7

Evolution of SSF catches

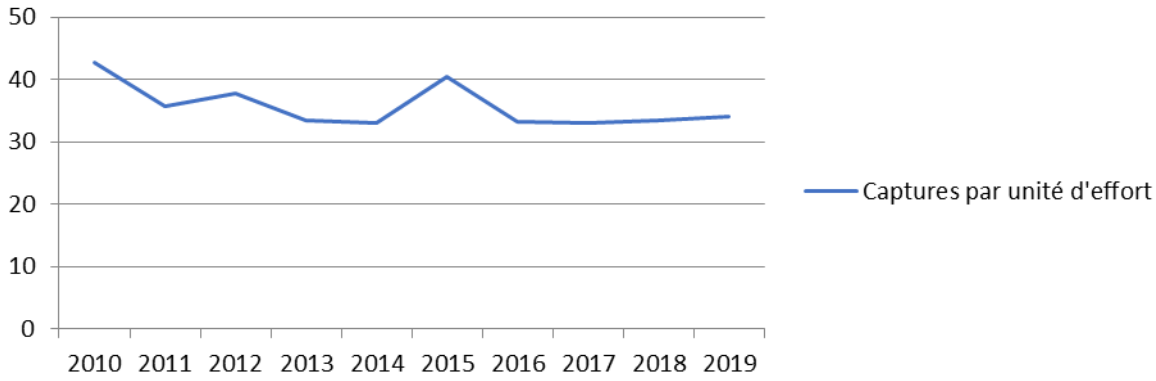


Note. Adapted from DPM, Senegal (2020).

SSF yields are measured by Catch Per Unit Effort (CPUE) and shown in Figure 8. CPUE is determined by the ratio between the quantity landed and the number of pirogues. They are evolving in a downward trend between 2010 and 2019. This decline in CPUE is pushing fishermen further away from the coast in search of fish. This behavior leads to an increase in production costs characterized by an increase in fuel consumption. Indeed, fuel consumption rose from 32513 liters in 2010 to 45861 liters in 2014 before falling to 42652 liters in 2015. It reached 63840 liters in 2016 compared to 69866 liters in 2017 and 60121 liters in 2018. As a result, the financial costs of fuel consumption increased from CFAF 17.859 million in 2010 to CFAF 29.702 million in 2018 (DPM, 2020).

Figure 8

Evolution of catches per unit effort



Note. Adapted from Author's computation.

4.2.2 Evolution of local consumption, fish trade and artisanal processing

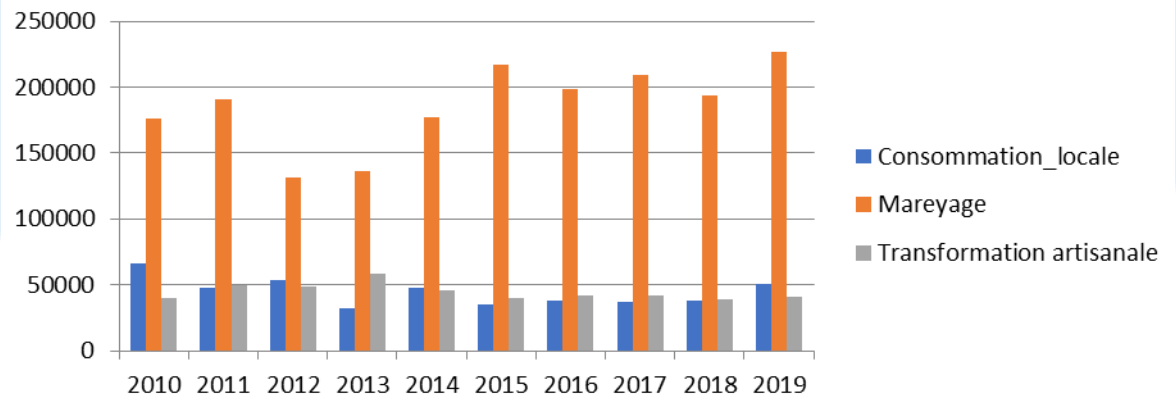
Local consumption fell almost by half, from 66,042 tons in 2010 to 34,759 tons in 2015. This may be due to the decrease in Etmalosis catches of around 45% in 2011 and 34% in 2012 (Baldé et al., 2019). Indeed, etmalosis is the main catch of small-scale fishing in Senegal. It is one of the fish species most consumed by local populations. A decrease in the catches of small pelagics would be a threat to the supply of local markets and to the satisfaction of the populations food needs. To remedy this situation, the distribution channels for fish products must be strengthened.

This decline in local consumption is also the result of the development of fish trade activities which are increasingly oriented towards more remunerative export markets. This has led fishers to target species with a high market value. This situation has led to pressure on the prices of fish products and the disruption of supplies to local markets. This can threaten the food security of local populations.

Since then, it has been on an upward trend to reach 50,810 tons in 2019. Fishing provides more than 72% of animal protein and 47% of total protein in the national diet. Small-scale processing has grown from 40001 tons in 2010 to 58652 tons in 2013. Since then, it has been stagnant. It went from 40,340 tons in 2015 to 41,202 tons in 2019. On the other hand, fish trade is on an upward trend, going from 130,985 tons in 2012 to 226,968 tons in 2019 (Figure 9).

Figure 9

Local consumption quantities, fish trade and artisanal processing



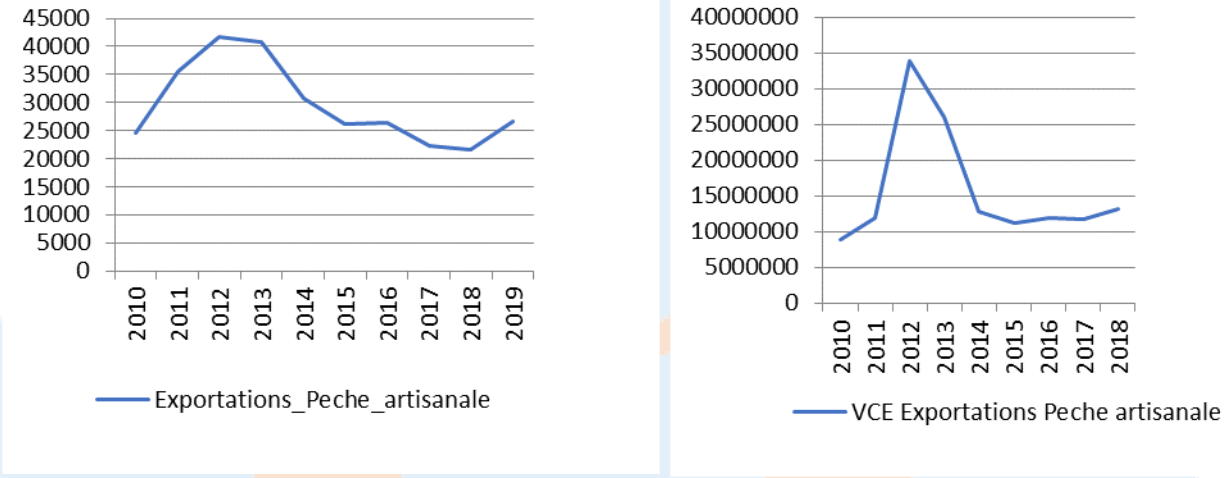
Note. Adapted from DPM, Senegal (2020).

4.2.3 Evolution of fisheries exports

SSF exports increased from 24493 tons for 894.754 million CFA francs in 2010 to 41699 tonnes for 33.897 billion CFA francs in 2012. Since then, they have evolved in a downward trend to reach 21614 tonnes for 13.162 billion CFA francs in 2018. The export in Senegal is shown in Figure 10.

Figure 10

Exports in quantity and value of artisanal fisheries

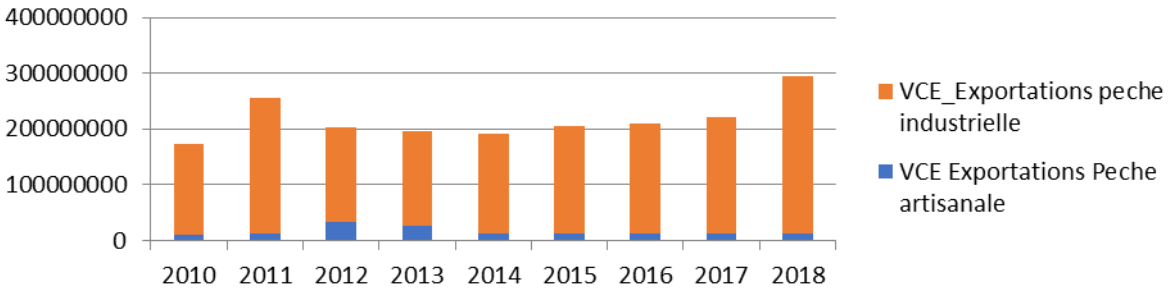


Note. Adapted from DPM, Senegal (2020).

Fisheries exports constitute the main source of foreign exchange in Senegal. In commercial values, the total exports of the fishing sector brought 173.539 billion FCFA in 2010 against 205.885 billion FCFA in 2015 before reaching 295.188 billion in 2018. About 95% of foreign exchange resources come from exports of industrial fishing (Figure 11).

Figure 11

Exports of artisanal and industrial fisheries



Note. Adapted from DPM, Senegal (2020).

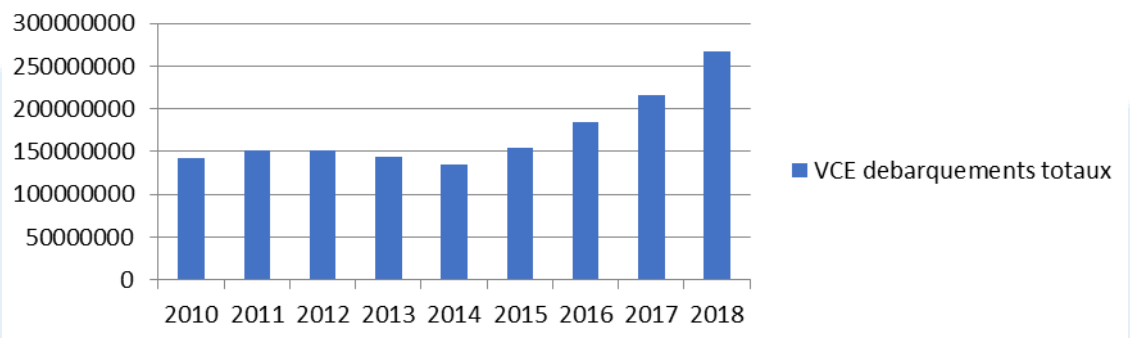
4.2.4 Evolution of the contribution to public income and GDP

The fisheries sector provides both fiscal and non-tax incomes to the state. These incomes come from vessel licenses, SSF permits and the financial counterparts of the fishing agreements. The counterpart of the fisheries agreement is 15 million euros or 10 billion CFA francs between 2014 and 2019. It is 30,507,750 Euros or approximately 2 billion CFA francs per year with the new agreement of July 2019.

The estimated commercial value of the fisheries sector is on an upward trend. It rose from 142.319 billion CFA francs in 2010 to 153.991 billion CFA francs in 2015 before reaching 266.676 billion in 2018. The value added generated by fishing represented 1.5% of GDP in 2017, compared to 1.6% of GDP in 2018. Fishing contributes by 10.7% of GDP in the primary sector (ANSD, 2020).

Figure 12

Trade values of the fisheries sector



Note. Adapted from DPM, Senegal (2020).

4.3 Causes and extent of climate change impacts on small-scale fisheries

4.3.1 Biological impacts of climate change

Climate change is leading to a reduction in marine biodiversity and losses of marine habitats. These climatic phenomena will have a negative impact on the productivity of fisheries resources. The degradation of marine ecosystems would modify the spatiotemporal variation of stocks and impact the redistribution of fish species.

Increased temperature may lead to a decrease in the diversity of species caught. These developments show more negative than positive impacts on fish yields. In Senegal, these impacts would be felt more by artisanal fishers who target, for the most part, pelagic resources (ethmaloses, sardinella). Indeed, pelagic resources are the main species caught. These resources would be more affected by ocean warming. The causes and potential biological risks are presented in table 6 below.

Table 6

Potential climate change-related impacts on fisheries

Variables	Potential impacts of climate change	Potential Causes and Risks
Landings	• Decline in pelagic catches • Decline in mollusc catches	• Declining yields and fish stocks
Catch size	• Smaller size • Decrease in commercial value	• Risk of loss of added value
Catch diversity	• Decrease in the number of species caught	• Risk of loss of fisheries biodiversity

Source: Authors

4.3.2 Economic and social impacts of climate change

At the microeconomic level, the effects of climate change are lower catches and turnover of fishing units, higher operating costs and lower incomes for operators in the value chain. These effects are difficult to estimate. Nevertheless, it must be recognized that climate change has led to the closure of some units of fishing companies in Senegal (REPAO, 2018).

At the macroeconomic level, climate change would lead to lower public incomes, slow down the growth of economic activities and fish exports. It would cause the loss of thousands of jobs linked to the closure of fish processing factories and threaten the food security of populations (Diouf, 2014).

Table 7

Economic and social impacts of climate change on fisheries

Variables	Potential impacts of climate change	Potential Causes and Risks
Fishing effort and operating costs	Duration of fishing trips Increasingly high operating costs More and more frequent accidents at sea	Financial and material losses
Related activities	Weakening of the value chain Decline in the level of processing and fish trade	Low diversification of related activities Decrease in the incomes of operators in the value chain
Incomes	Decrease in turnover	Decline in fishermen's income
Exports	Decline in fisheries exports Decline in foreign exchange inflows	Risks related to the increase of the trade deficit
Jobs	Closure of fish processing units	Risks of massive job losses
Poverty	Increase in the poverty level of fishing communities	Risks linked to the lack of financial and material resources of fishermen
Food Security	Decline in the level of local consumption Deterioration of food security	Risks related to difficulties in supplying the local market
Social conflicts	Frequent conflicts between groups of fishermen	Risk of social unrest and intensification of the crisis in the fisheries sector
Vulnerability of fishing communities	Collapse of the local economy Pauperization of fishing communities	Risks related to the high dependency of the fisheries sector

Source: Authors

5. Challenges and opportunities in small-scale fisheries

5.1 Challenges in the face of climate change

The main environmental challenges facing the fisheries sector today are the destruction of marine ecosystems, the degradation and overexploitation of fisheries resources (O'Dea et al., 2011), marine pollution, acidification and salinization of some areas and coastal erosion threatening coastal infrastructure. The economic challenges are essentially linked to the drop in the profitability of small-scale fishing production and export units, which would be caused by the drop in fish catches.

The main social challenges of SSF are food security, creation of employment opportunities, poverty reduction, management of fishermen's migration and social conflicts. The instability of fishers' incomes can make them vulnerable or expose them to migration. Migratory fishing is source of social conflict and causes serious problems in Senegal and the sub-region.

The policy and governance challenges in fisheries are mainly related to the failure of the government to manage the fisheries and inadequate enforcement and compliance with regulations on catches and fishing gear used.

5.2 Opportunities in small-scale fisheries

Here, we identify several opportunities in SSF in Senegal. They include:

- *Fishing potential*: Senegal has 718km of coastline. Senegal's coasts are among the most abundant areas of fish in the world.

- *Aquaculture potential*: aquaculture, an alternative to the overexploitation of fisheries resources, is being developed and diversified in Senegal.

- *Growing demand for fishery products*: fishery products are among the most traded products in the world. Fishing and aquaculture provide more than half of the fish for human consumption (FAO, 2014).

- *Diversification of fishery products through processing:* exports of products are dominated by fresh products. Improving the level of processing of fishery products and diversifying them would increase the added value of the sector.

- *Promoting responsible and sustainable fishing:* Improved management systems for fishing licenses and permits and the registration of pirogues would strengthen surveillance and combat illegal fishing. The FAO Sustainable Fisheries Management Guidelines should be implemented for better governance of small-scale fisheries and promotion of blue growth (FAO, 2016).

- *Marine protected areas, artificial reefs and fish aggregating devices:* the creation of many MPAs, floating or submerged solid complexes, which protect natural habitats, increase biological productivity and promote fish aggregation for management, conservation or exploitation.

6. Policy and Governance

6.1 Fisheries policies and climate change adaptation strategies

At the international level, the main fisheries management policies and projects include:

- *International conventions and agreements:* these include the 1992 Convention on Biological Diversity ratified in June 1994, the 1994 United Nations Framework Convention on Climate Change and the 2001 Kyoto Protocol.

- *The ECOWAS Integrated Maritime Strategy and Common Fisheries Policy* aim to establish a prosperous maritime domain and to facilitate the exchange of information on the fisheries sector.

- *The sub-regional Canary Current Large Marine Ecosystem Protection Project* initiated by FAO and UNEP to combat the degradation of the Canary Current ecosystems.

- *Adaptation to Climate and Coastal Change in West Africa Project* funded by UNDP/GEF

At the national level, fisheries strategies, development and management plans are accompanied at the local level by Local Development Plans or specific local plans. The main national regulations include:

- *The National Strategy for the Management of Protected Areas* aims to promote and enhance Senegal's MPAs through a coherent network of MPAs managed in a participatory way.

- *The 2001 Strategy for the Sustainable Development of Fishing and Aquaculture* aims to ensure the sustainable management of fishing and aquaculture, the viability of fisheries, to satisfy national demand for fish products, to improve the conditions for small-scale fishing, to enhance the value of fish production, and to develop a sustainable system for financing fishing and aquaculture.

- *The National Action Plan for the Environment in September 1997 and implemented in 1999* with the support of the GEF, which accompanies the State in anticipating and resolving problems related to sectoral vulnerabilities to climate change, including fishing.

- *The National Action Plan for Adaptation to Climate Change in 2006* led to the establishment of a National Committee for Climate Change and an Adaptation Fund, whose Ecological Monitoring Centre has been responsible for studying the admissibility and relevance of projects and their monitoring and evaluation since 2010.

- *The National Sectoral Plan for Adaptation to Climate Change in Fisheries and Aquaculture for 2035* aims to integrate adaptation to climate change into fisheries development policies and strategies.

- T*he Sectoral Policy Letter for Fisheries and Aquaculture for 2008-2013.* It aims at the sustainable management and restoration of fisheries resources, the satisfaction of national demand, the optimal development of resources, the qualification of professionals and the financing of activities. A second Letter of Sectoral Policy for the Development of the Fisheries and Aquaculture Sector for 2016-2023 should eventually allow the development of aquaculture, the strengthening of food security, economic growth and local development.

In Senegal, the implementation of productive policies initiated during the period from the 1960s to the 1990s has led to the development of fishing activities oriented towards external markets. The satisfaction

of the rapidly growing external demand has led to an increase in the pressure on fishery resources and the overexploitation of stocks, particularly coastal demersal species. This overexploitation of resources is amplified by the inadequacy of the enforcement of regulations and the shortcomings of the fisheries monitoring and control systems (Kébé, 2008). This situation has led, since the 2000s, to a renewed interest in the sustainable management and restoration of fishery resources, the satisfaction of national demand, the improvement of the value of fishery production and the financial viability of fishing activities. In this perspective, the public authorities have initiated a series of activities, including, the co-management of fisheries, the creation of marine protected areas, the introduction of biological rest, the immersion of artificial reefs, the development plans of demersal fisheries, the registration of pirogues and the adjustment of fishing capacity. In addition, the experimentation of the eco-labeling of fishery products, which should allow better fishing and better sales, is one of the solutions to the viability of artisanal fisheries in Senegal.

6.2 Projects and programs for the development of small-scale fisheries

Three periods mark the implementation of projects in the fisheries sector in Senegal. The first period extends from the 1950s to 2000. The second is from 2000 to 2012. The third covers the period from 2012 to 2020. The difficulties in implementing these programs are attributable to the lack of political commitment on the part of state and local authorities, the lack of coordination and the overall inconsistency between state-sponsored programs. Tables 8, 9 ans 10 address key projects carried out in Senegal from 1950 to 2020.

Table 8

Projects carried out between 1950-2000

Projects/Programs	Areas of intervention	Periods
Pirogues Motorisation Projects	Saint-Louis and national level	1952-1953
FAO-CRODT project on purse seines	‘’Petite Côte’’ and national level	Since 1969 disseminated from 1973
Pirogues Motorization Assistance Center	Mbour, Joal, Dakar	1972-1994
Refrigeration equipment programme	Interior regions	Since 1975
Senegal Small Scall Fishing Assistance Center Project	Kayar, Joal, Rufisque	1978-1987
‘’Petite Côte’’ Small Scale Fishing Development Project	Joal, Kaolack, Fatick, Rufisque	1988-1995
Maritime Small Scale Fishing Development Project in Ziguinchor Region	Ziguinchor	1987-1992
Fishing and Related Industries Incentive Fund	National	1960-1967
Assistance, extension and experimentation center for Small Scale Fishing pirogues	National	1994-2003
Center for Development, Experimentation and Extension for Fisheries	National	Since 2003
Small Scale Fishing project in Casamance	Casamance	1995-1998
Senegal Small Scale Fishing Assistance Program	Maritime regions (‘’Grande Côte’’, ‘’Petite Côte’’)	1988-1993
«*Narou Heuleuck*» Project	Delta du Saloum	1993-2003
North and South Small Scale Fishing Support Project	‘’Grande Côte’’, ‘’Petite Côte’’, Casamance	1995-2005
Support for a sustainable and equal management of the fishing sector in Senegal	National	1999-2004

Table 9

Projects carried out between 2000-2012

Projects/Programs	Areas of intervention	Periods
Sustainable livelihoods program in Small Scale Fishing	West Africa	2000-2005
Regional Coastal and Marine Conservation Program	West Africa	Since 2000
Refrigeration program	Saint-Louis, Yoff, Yenne, Mbour, Ziguinchor, interior localities	2000-2002
Preservation of fishery resources by fishing communities	Rufisque, Bargny, Saloum, Mbour	2001-2005
Technical support for the definition of a system for granting access rights to EEZ resources	National	2002-2003
Pilot project for the protection and management of fishery resources in Senegal	Hann, Rufisque, Cayar	2002-2003
WWF West Africa Marine Program	Mauritania, Senegal, Gambia, Guinea Bissao, Guinea, Capo-Verde	2002-2005
Support Project for the Sustainable Management of Fisheries Resources in West Africa	Capo-Verde, Gambia, Guinea, Guinea-Bissao, Mauritania, Senegal et Sierra Leone	2002-2010
Fisheries - Trade - Environment Program in West Africa	West Africa	2003 - 2005
"Wula-Nafa" Natural Resources Management Project	Sokone (Delta du Saloum) et Région de Ziguinchor	2003-2008
Senegal Integrated Ecosystem Management Project	Delta du Saloum	2003-2013
Support for maritime surveillance of the West African coastal zone	West Africa	2004-2008
Support for the Management and Creation of MPAs	West Africa	2004-2008
Sustainable management of shared stocks of Argyrosomus regius and Mugilidae in Mauritania and Senegal	West Africa	2004-2008
Integrated Marine and Coastal Resource Management	EEZ and coastal zone	Initially planned between 2005-2010
Italian Food Security Programme/FAO	Commune of Toubacouta(Delta du Saloum)	2008-2012
Sustainable Fisheries Project in The Gambia and Senegal "Ba Nafaa	Gambia, Senegal	Since october 2009
Sustainable management of fisheries resources project	Dakar, Delta du Saloum, ''Petite Côte''	2009-2012
Co-management Programme in Small Scale Fishing in Senegal	Lompoul, Cayar, Joal, Djifère	2009-2013
Capacity building for Small Scale Fishing	Saint-Louis and Lompoul	2010-2013
Regional fisheries programme in West Africa	Thiès, Dakar, Fatick, Ziguinchor	2010-2016
Coastal erosion adaptation project in vulnerable areas in Senegal	Joal, Saly, Rufisque	2010-2014
USAID Collaborative Management for Sustainable Fisheries Project	Thiès, Dakar, Fatick, Kolda, Sédhiou, Ziguinchor	2011-2018

Table 10

Projects carried out between 2012-2020

Projects/Programmes	Areas of intervention	Periods
Sustainable management of Senegalese fisheries project	National	2012-2016
Promotion of fisheries co-management through value chain development	Mbour (Thiès)	2014-2017
Refrigeration Programme Phase 2	National	2018-2020
West African Coastal Management Programme	Saint-Louis, Bargny, Sangomar, Iles du Saloum, Casamance	From 2018
Mangrove Forest Management Project from Senegal to Benin	West Africa	From de 2019

6.3 Fisheries governance in Senegal

6.3.1. Legal framework for fisheries governance

Various legislative and regulatory documents frame the governance of fisheries in Senegal. They include the National Domain Law (Law N° 64-46 of 17 June 1964), the Local Government Code (Law N°96-06 of 22 March 1996, Law N°2013-10 of 28 December 2013), the Environment Code (Law N°83-05 of 28 January 1983, Law 2001-01 of 15 January 2001) and the Maritime Fisheries Code (Law N°98-32 of 14 April 1998, Law N°2015-18 of 13 July 2015).

The Maritime Fisheries Code from 1998 instituted the creation of the National Advisory Council on Maritime Fisheries (CNCPM), the Local Small-Scale Fishing Councils (CLPA) and the introduction of the SSF permits. The Law n° 2015-18 of July 13, 2015, on the Maritime Fishing Code in Senegal[4] introduced provisions to combat illegal, unreported and unregulated fishing, co-management of fisheries and the strengthening of fisheries management plans.

Other regulatory mechanisms involve fishing rights (i.e., fishing licenses for vessels and SSF permits) and the registration of pirogues. In practice, SSF permits are not yet applied to all units due to the reluctance of some fishers to comply.

6.3.2. Centers of power in fisheries governance

In Senegal, there are four centers of governance. They are: political powers, local community, local partners and external partners, as explained below. It is noteworthy that at the national level, difficulties exist and are linked to the inconsistency of interventions and the lack of synergy between the different institutions.

Political powers concern governmental institutions and other decentralized services that intervene indirectly or directly in the governance of fisheries. There is the Directorate of Maritime Fisheries, the Directorate of Inland Fisheries and Aquaculture, the Directorate of Fisheries Protection and Surveillance, the Directorate of Fisheries Processing Industries, the Directorate of Management and Exploitation of Marine Funds, the Directorate of Environment and Classified Establishments, the Directorate of National Parks, the Directorate of Community Marine Protected Areas, the National Committee for Adaptation to Climate Change.

[4] République du Sénégal (2015). Loi portant code de la pêche maritime, Journal officiel du Sénégal, 21p. http://www.jo.gouv.sn/spip.php?page=imprimer&id_article=10425

National Agencies and technical services support the State in the governance of fisheries resources: the Agency for the Promotion of Aquaculture, the National Agency for Maritime Activities, the High Authority in charge of coordinating Maritime Safety, Maritime Security and Environmental Protection, the National Agency for Civil Aviation and Meteorology, the High Council of Territorial Collectivities, and the National Commission for the Support of Fisheries Management in Senegal. The research structures involved in fisheries governance are the research centers (CRODT/ISRA, CSE, IRD) and the university institutes (IUPA, ISE).

Civil society and local communities are represented by the National Council of Small-Scale Fishing Fishermen of Senegal, the National Federation of Economic Fishing Interest Groups of Senegal, the National Council of Management in Senegal, the Group of Shipowners and Industrialists of Senegal and the National Advisory Council on Maritime Fisheries (CNCPM). Community organizations are Local Authorities, Local Small-Scale Fishing Councils (CLPAs) and Local Village Fishing Committees (CLVs).

Finally, external partners involve sub-regional fisheries institutions (Fisheries Cooperation between African States bordering the Atlantic Ocean, Fisheries Committee for the Central-East Atlantic, Sub-Regional Fisheries Commission), non-governmental organizations and international foundations (IUCN, WWF, FIBA, OCEANIUM), international financial institutions (WB, FAO, UNEP, GEF), other international partners (USAID / COMFISH, AFD).

6.3.3 Fisheries governance modes: governmental management and co-management

In Senegal, the first fisheries governance systems were characterized by the state's monopoly on the protection, conservation, control, monitoring and use of fisheries resources (Weigel & Sarr, 2002; Froger & Gallietti, 2007). This system has revealed several limitations such as the faillings of fisheries management and financial disengagement of the government(Dahou et al., 2004; Féral, 2007).
With the financial disengagement of states, NGOs have become the main funders of local management of fisheries resources. This has resulted in a change in social relations, sometimes characterized by conflicts of interest between the different poles of governance (Féral & Cazalet, 2007).

Faced with the limitations of state management, the Senegalese state has advocated local governance and co-management of fisheries resources. Local governance aims to involve local communities in the decision-making processes and to strengthen their powers in the management of fisheries resources (Plante & André, 2002). In Senegal, the local professional organizations involved in fisheries management are the Economic Interest Group (EIGs), Local Small-Scale Fishing Councils (CLPAs) and Local Village Fishing Committees (CLVs).

Co-management is a democratic, participatory and decentralized resource management process (Pomeroy & Rivera-Guieb, 2006). The main forms of co-management are community-based management, subsidiarity and partnership. In Senegal, the 2015 Maritime Fisheries Code advocates co-management of fisheries resources in Section 5, Article 6 with professional fisheries organizations, communities and all relevant stakeholders. To this end, the Small-Scale Fishing Division is responsible for setting up CLPAs and CLVs throughout the country. Co-management can allow to resolve social conflicts and ensure equitable exploitation of fisheries resources.

7. Conclusions

In Senegal, SSF play a key role in economic and social development policies and strategies, through its significant contribution to feeding the population, as well as to the creation of income and jobs. Fish is an important source of animal protein for the Senegalese populations, to whom it provides approximately 70% of protein. The main actors in SSF are males, but women still carry an essential role, particularly in the liaison between the fishers and the consumer. In fact, occupy a prominent place in the sector both in terms of distribution and processing.

The situational analysis of the Senegalese SSF sector highlights the difficulties faced by the sector due to the strong pressure exerted on resources, climate change, poor governance, etc. This, coupled with poor management and irrational exploitation of fishery resources, risks to jeopardize the sustainability of the sector.

Efforts to address the management of fisheries in Senegal proved unsuccessful because the current models of fisheries management were not suitable to SSF. As they failed to adapt to the needs to SSF small scale fisheries they still represent a significant issue that remains to be solved.
The solution to this problem must entail efficient governance of the sector with a view to ensuring sound management and sustainable use of the fishery resource in order to help the sector transit from vulnerability to viability.

References

Agence Nationale de la Statistique et de la Démographie (ANSD) (2008). *Rapport sur la pêche artisanale.* https://www.ansd.sn/ressources/ses/chapitres/9-Peche-maritime_2008.pdf

Agence National de la Statistique et de la Démographie (ANSD) (2019). *Situation Économique et Sociale du Sénégal 2017-2018.* Ministère de l'économie, du plan et de la Coopération, République du Sénégal. pp. 245-257. https://www.ansd.sn/index.php?option=com_ansd&view=titrepublication&id=56

Agence Nationale de la Statistique et de la Démographie (ANSD) (2020). *Situation Economique et Social du Sénégal, Edition 2017-2018*, Juillet 2020. https://www.ansd.sn/ressources/publications/12-SES-2017-2018_Peche-aquaculture.pdf

Bah, A. B. (2016). Changements climatiques et intensification durable au Sénégal: Une étude de cas du système de production biologique des légumes dans la zone des Niayes, 136p. https://www.globalissues.org./article/233/climate-change-and-global-warming-introduction

Barusseau J. P, Diop, E. S. & Saos, J. L. (1983). Caractére hydrodynamique. In: Atelier d'étude des mangroves au sud de l'estuaire du Saloum: Diomboss-Bandiala (Sénégal). Rapp. Fin.: 1128. https://www.documentation.ird.fr/hor/fdi:010004639

Berrit, G. R. (1952). Esquisse des conditions hydrologiques du plateau continental du Cap Vert à la Gambie. FAO, AGRIS. https://agris.fao.org/agris-search/search.do?recordID=AV2012086999

Bousso, T. (1994). *Typologie des engins et techniques de pêche artisanale utilisés au Sine-Saloum (Sénégal)*. Centre de Recherches Océanographiques de Dakar-Thiaroye. https://www.researchgate.net/profile/Tidiane-Bousso/publication/320718896_Typologie_des_engins_et_techniques_de_peche_artisanale_utilises_au_Sine-Saloum_Senegal/links/5b50d7f345851507a7b1ea50/Typologie-des-engins-et-techniques-de-peche-artisanale-utilises-au-Sine-Saloum-Senegal.pdf

Camara, M. M. B. (2008). *Quelle gestion des pêches artisanales en Afrique de l'Ouest? Etude de la complexité de l'espace halieutique en zone littorale sénégalaise* [Doctoral dissertation, Tesis doctoral inédita]. Dakar, Université Cheikh Anta Diop. http://www.rampao.org/IMG/pdf/quelle_gestion_des_peches_artisanales_en_afrique_de_l_ouest_etude_de_la_complexite_de_l_espace_halieutique_en_zone_littorale_senegalaise-2.pdf

Cissé, I., & Cissé, A. W. (2020). Pêcheries Artisanales et Droits Humains au Sénégal: Contribution á L'atteinte de la Cible 14b des Objectifs de Développement Durable (ODD)/Artisanal Fisheries and Human Rights in Senegal: Contribution to achieve target 14b of the SDG. https://www.africaportal.org/publications/p%C3%AAcheries-artisanales-et-droits-humains-au-s%C3%A9n%C3%A9gal-contribution-%C3%A1-latteinte-de-la-cible-14b-des-objectifs-de-d%C3%A9veloppement-durable-odd-artisanal-fisheries-and-human-rights-in-senegal-contribution-to-achieve-target-14b-of-the-sdg/

CRODT (2019). Statistiques de la pêche maritime sénégalaise: Pêche artisanale en 2019.

Dacosta, H. (1989). Précipitations et écoulements sur le bassin de la Casamance. These Doctorat. Available at: https://www.researchgate.net/profile/Honore-Dacosta/publication/32981850_Precipitations_et_ecoulements_sur_le_bassin_de_la_Casamance/links/5628259508ae22b1702d9f17/Precipitations-et-ecoulements-sur-le-bassin-de-la-Casamance.pdf

Dahou, T., Weigel, J. Y., Saleck, A., Da Silva, A. S., Mbaye, M., & Noël, J. F. (2004). La gouvernance des aires marines protégées: leçons ouest-africaines. *VertigO-la revue électronique en sciences de l'environnement*, *5*(3). https://journals.openedition.org/vertigo/3327

Déme, M., & Kebe, M. (2000). Revue sectorielle de la pêche au Senegal: aspects socio-economiques. https://aquadocs.org/bitstream/handle/1834/184/RevueSectorielle.pdf?sequence=1

Diaw, N. Y. (1997). Le crédit à la pêche artisanale au Sénégal. Available at: Le credit a la pêche artisanale au Senegal (Credit for artisanal fisheries in Senegal). FAO LIBRARY AN:383099 https://www.fao.org/3/an673f/an673f.pdf

Diouf, P. S., (2014). Innovations technologiques de la pêche artisanale sénégalaise et leurs impacts sur les ressources halieutiques, APTE, 3p.

Féral, F. (2007). L'administration des aires marines protégées en Afrique de l'Ouest. *Mondes en développement*, (2), 43-60. https://www.cairn.info/revue-mondes-en-developpement-2007-2-page-43.htm

Féral, F. & Cazalet, B. (2007). Les objectifs et les fonctions des aires marines protégées. in Weigel, J.Y., F. Féral & B. Cazalet. Les aires marines d'Afrique de l'Ouest. Gouvernance et politiques publiques, pp.25-38. https://www.researchgate.net/profile/Jean-Yves-

Weigel/publication/280635385_Les_aires_marines_protegees_d'Afrique_de_l'Ouest_gouvernance_et_politiques_publiques/links/560d3f0808ae6cf68153b0ff/Les-aires-marines-protegees-dAfrique-de-lOuest-gouvernance-et-politiques-publiques.pdf

Food and Agriculture Organization of the United Nations (FAO) (2014). La situation mondiale des pêches et de l'aquaculture: Possibilités et Défis. Rome, 2014, 275p. https://www.fao.org/3/I3720F/i3720f.pdf

Food and Agriculture Organization of the United Nations (FAO) (2016). Directives de Gestion Durable des Pêches. https://www.fao.org/voluntary-guidelines-small-scale-fisheries/guidelines/resource-management/fr/

Food and Agriculture Organization of the United Nations (FAO) (2018). La situation mondiale des pêches et de l'aquaculture 2018. Atteindre les objectifs de développement durable. Rome. Licence: CC BY-NC-SA 3.0 IGO. https://www.fao.org/3/i9540fr/i9540fr.pdf

Froger, F. & Galletti, F. (2007). Introduction, *Mondes en développement*, 35-2007/2 (138), 7-10. http://www.cairn.info/article.php.

GIEC (2014). Changements climatiques: Impacts, vulnérabilité et adaptation. 5ème Rapport du GIEC sur le Changement climatique. Résumé à l'intention des décideurs, 42 p. https://leclimatchange.fr/impact-adaptation-vulnerabilite/

Gies, E. A., Konwar, K. M., Beatty, J. T., & Hallam, S. J. (2014). Illuminating microbial dark matter in meromictic Sakinaw Lake. *Applied and environmental microbiology*, 80(21), 6807-6818. https://journals.asm.org/doi/full/10.1128/AEM.01774-14

IPCC (2014) Summary for policymakers In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects.Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change ed C B Field et al Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA, pp 1-3.

Ka, R., & Gueye, E. (2020). La Peche Artisanale Face aux Defis de la Covid-19 au Senegal/Artisanal Fisheries in Senegal Facing the Challenges of Covid-19. Initiative prospective Agricole et rural. https://media.africaportal.org/documents/rapport_final_peche_et_covid-19__vf.pdf

Kebe, M. (2008). Le secteur des pêches au Sénégal: Tendances, enjeux et orientations politiques. Available at: https://aquadocs.org/bitstream/handle/1834/4586/Rapport_peche_FKF_VF.pdf?sequence=1

Le Douguet, L. (2009). Guide de reconnaissance des engins et filets de pêche artisanale utilisés dans les Aires Marines Protégées d'Afrique de l'ouest. Available at: http://aires-marines.uqar.ca/id/eprint/36/

Le Roux, S. (2005). *Pêche et territoires au Sénégal* (Doctoral dissertation, Université de Nantes). Available at: https://hal.univ-brest.fr/tel-00010547/

Mbaye, L. (2005). *Etat des lieux de la filière de transformation artisanale des produits halieutiques au Sénégal* [Master's thesis]. https://aquadocs.org/bitstream/handle/1834/5001/Etude_sur_produits_halieutiques_VProvisoire.pdf?sequence=1

Mbaye A., Thaim N. & Fall M. (2018). Les zones de pêche protégées au Sénégal : entre terroir du pêcheur et parcours du poisson. Quelle(s) échelle(s) de gestion Développement durable et territoires Vol. 9, n°1 | Mars 2018, mis en ligne le 30 mars 2018, consulté le 04 avril 2018. https://www.researchgate.net/publication/324233892_Les_zones_de_peche_protegees_au_Senegal_entre_terroir_du_pecheur_et_parcours_du_poisson_Quelles_echelles_de_gestion [accessed Dec 16 2021]

Ministére de l'Environnement et de la protection de la Nature (MEPN) (2010). Quatrième rapport national sur la mise en œuvre de la convention sur la diversité biologique. https://wedocs.unep.org/handle/20.500.11822/9101;jsessionid=4B149E3C929AD3B51940D0DA27428C48

Ministère de la pêche et de l'économie maritime (MPEM) (2018). Résultats généraux des Pêches Maritimes 2018. Bureau des statistiques. https://www.oceandocs.org/bitstream/handle/1834/15921/R%C3%A9sultats%20g%C3%A9n%C3%A9raux%20des%20p%C3%AAches%202018%20final.pdf?sequence=1&isAllowed=y

Ndiaye, J. L. (1997). *Une activité dynamique au sein d'un système complexe: rôle et place de la transformation artisanale dans le" système pêche maritime" au Sénégal: étude de géographie économique* (Doctoral dissertation, Montpellier 3). https://www.theses.fr/1997MON30070

Niang, N. A. (2009). *Dynamique socio-environnementale et développement local des régions côtières du Sénégal: l'exemple de la pêche artisanale* (Doctoral dissertation, Université de Rouen). https://tel.archives-ouvertes.fr/tel-00561298/

O'Dea, A., Tobey, J., Soumaré, A.,Virginia, L. & Dia, M. I. (2011). L'Atelier Régional de l'Afrique de l'Ouest sur les Changements Climatiques, Pêcheries, et AMPs. Coastal Resources Center, University of Rhode Island, et WWF-WAMER, 32p. https://www.crc.uri.edu/download/Proceedings_CCA_Workshop_Report_French.pdf

OMVG. (2014). Étude d'impact environnemental et social du projet énergie (revue du rapport coteco 2008) projet de rapport final. P.637. https://www.omvg.org/

André, P., & Plante, S. (2002). La gestion communautaire des ressources naturelles, cadre de référence pour une réflexion sur les communautés locales. *Canadian Journal of Regional Science*, *25*. https://idjs.ca/images/rcsr/archives/V25N1-plante-andre.pdf

Pomeroy, R. S. & Rivera-Guieb, R. (2006) Fishery Co-Management: A Pratical Handbook. Wallongford, UK: CAB International. 273p. ISBN 1-55250-184-1.

REPAO (2018). Gestion des risques induits par le changement climatique dans la pêche artisanale en Afrique de l'Ouest, Rapport Final de l'Étude, 195p file:///C:/Users/salle%20prof/Downloads/Rapport%20GIZ.pdf

République du Sénégal. (2016). Plan national d'adaptation du secteur de la pêche et de l'aquaculture face au changement climatique horizon 2035; Ministry of environment and sustainable development / Ministry of fishing and maritime economics

Sall, A., Déme, M. & Diouf, P. S. (2006). L'évaluation des emplois dans les pêcheries artisanales maritimes sénégalaises. Bureau du programme marin pour l'Afrique de l'Ouest du WWF.

Seck, P. A. (1980). *Catalogue des engins de pêche artisanale du Sénégal*. Food and Agriculture Organization of the United Nations.

Thior M., Diéye E. B., & Sané T. (2020). Érosion côtière et impacts socio-économiques de la commune de Diémbéring en absse Casamance. Bulletin de l'IFAN Ch. A. Diop Série B, Sciences humaines. Numéro ISSN 0018-9642

Weigel, J. Y. & O. Sarr (2002). Analyse bibliographique des aires marines protégées. Références générales et régionales, IRD. Dakar. Juillet 2002. Ref.:CONSDEV Synthèse/WP1/02, 21p.

Weissenberger, S., Noblet, M., Plante, S., Chouinard, O., Guillemot, J., Aubé, M., ... & Seck, A. (2016). Changements climatiques, changements du littoral et évolution de la vulnérabilité côtière au fil du temps: comparaison de territoires français, canadien et sénégalais. *VertigO-la revue électronique en sciences de l'environnement*, *16*(3). https://journals.openedition.org/vertigo/18050

Vulnerability to Viability (V2V) Global Partnership

The Vulnerability to Viability (V2V) project is a transdisciplinary global partnership and knowledge network. Our aim is to support the transition of small-scale fisheries (SSF) from vulnerability to viability in Africa and Asia. Vulnerability is understood as a function of exposure, sensitivity and the capacity to respond to diverse drivers of change. We use the term viability not just in an its economic sense but also to include its social, political, and ecological dimensions.

The V2V partnership brings together approximately 150 people and 70 organizations across six countries in Asia (Bangladesh, India, Indonesia, Japan, Malaysia, Thailand), six countries in Africa (Ghana, Malawi, Nigeria, Senegal, South Africa, Tanzania), Canada and globally. This unique initiative is characterized by diverse cultural and disciplinary perspectives, extensive capacity building and graduate student training activities, and grounded case studies from two regions of the world to show how and when SSF communities can proactively respond to challenges and creatively engage in solutions that build their viability. Further information on the V2V Partnership is available here: www.v2vglobalpartnership.org.

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