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Review Paper

## A Comprehensive Overview of the Current Fisheries Status in Sierra Leone

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doi: [10.33472/AFJBS.6.6.2024.8028-8056](https://doi.org/10.33472/AFJBS.6.6.2024.8028-8056)**ABSTRACT:**

Sierra Leone's fishing sector, rich in seafood stocks such as pelagics, demersals, crustaceans, sharks, and rays, plays a vital role in the nation's economy and food security. Supported by the nutrient-rich Guinea Current Large Marine Ecosystem (GCLME) and the Canary Current Large Marine Ecosystem (CCLME), these resources sustain both industrial and artisanal fisheries. Artisanal fisheries, divided into aquaculture and inland and marine categories, contribute significantly, with fish accounting for approximately 80% of the animal protein consumed daily by Sierra Leoneans. Despite its potential, the sector is hindered by inadequate management, infrastructure, and investment in advanced technology, leading to stagnation over the past 30 years. The artisanal fleet is poised for growth if restrictive measures are not implemented, due to insufficient effort control. Unlicensed fishing and a lack of scientific and technological advancement among local fishermen exacerbate these challenges, threatening food security and economic growth. Effective management strategies are crucial, necessitating thorough independent stock assessments and robust guidelines to address ungoverned and illegal fishing activities. Institutions for marketing, certifying resource ownership, and supplying inputs are also needed. Highlighting the importance of small pelagic species like mackerels, Bongo, Lati, and Herring, the Ministry has proposed specific management strategies aimed at restoring fisheries and the environment. By addressing these issues, Sierra Leone can unlock the fishing sector's potential to alleviate poverty and drive economic advancement. The implementation of comprehensive management measures and investment in technological and infrastructural improvements are essential for ensuring the sector's sustainable growth and contribution to the nation's development.

**Keywords:** Sierra Leone, Fishery industry, Fishery stock, Fishery challenges, Sustainable Fishery, Marine Policy, Conservation, SDG

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**1. Introduction on Current Situation of Fisheries in Sierra Leone**

There is growing concern regarding the health of global fish stocks and the repercussions of their depletion on food security and the economy of most vulnerable countries (FAO, 2016). West African countries heavily rely on fish as one of the principal sources of protein and as a source of income and employment for nearly 7 million people (Belhabib *et al.*, 2015).

Sierra Leone has a diverse and valuable array of fish stocks in marine and inland environments that are exploited mainly through fishing and a limited number of aquaculture systems. According to the Ministry of Fisheries and Marine Resources (MFMR), the current total annual fishery production is approximately 150,000 tons (Nakamura *et al.*, 2023). The marine artisanal fishing subsector, characterized by small-scale, in-shore, low-technology operations, accounts for the bulk of this catch (120,000 tonnes, valued at USD. 360 million annually) (Neiland *et al.*, 2016). The marine industrial fishing subsector catches an estimated 24,000 tons, valued at USD 25 million per year. Both inland fisheries and aquaculture production were relatively small in comparison to marine capture fisheries.

The country's marine ecosystem is favored by the Guinea Current Large Marine Ecosystem (GCLME) and the Canary Current Large Marine Ecosystem (CCLME), which are rich in nutrients and support large quantities of pelagic and demersal fish resources. The shared stocks of small pelagics migrate along the Northwest African coast, where they are exploited by the artisanal and industrial sectors, including local fleets and foreign fishing vessels from Europe and Asia (Froese and Pauly, 2024).

### **Economic Importance of Fisheries**

The fishery sector is a vital component of the Sierra Leone economy. Sierra Leone's fisheries resources have an estimated capitalized economic value of USD 735 million. Fish catches from the sector are worth an estimated first-sale value of over US \$ 200 million annually. This sector contributes more than 10 percent of the country's GDP. The total annual production is estimated at 228,000 tons (Massaquoi, Roberts and Tian, 2021). The fisheries sector provides direct employment to some 200,000 persons and indirect employment to some 600,000 individuals, constituting almost 10 percent of the population along coastlines in western areas, Kambia, Port Loko, Moyamba, Pujehun, and Bonthe (Okeke-Ogbuafor *et al.*, 2024). Specifically, in coastal areas, an estimated 25 percent of the male population of working age is involved in part-time fishing. The marine artisanal catch is estimated to account for approximately 150,000 tons, and the industrial catch production is estimated to be 78,000 tons.

Sierra Leone boasts 570 km of coastline and a continental shelf area of approximately 30,000 square kilometers, which contains commercially viable stocks of pelagic and demersal fish resources. High-value exportable fish include snapper, grouper, catfish, barracuda, tuna, cuttlefish, squid, lobsters, herring, and Sea Bream. Sierra Leone has a comparative advantage in West Africa, hosting a high fishery biomass comprising shrimp, demersal finfish, pelagic, and tuna fisheries (<https://www.sliempa.gov.sl/industries/marine-fisheries/policy-and-regulations>).

### **Historical context and significance of the industry**

The political climate in Sierra Leone was generally unstable until 2002, which negatively affected the fisheries sector. This instability was evidenced by the ever-changing stewardship authority and the lack of effective fisheries policy instruments until 2003 (Sei and Baio, 2018). For over ten years (1991-2002), Sierra Leone was torn apart by a civil war that paralyzed its economy, crippled its public sector, destroyed its infrastructure, and heavily changed its public authorities in implement management measures to the fullest extent.

Since the end of the armed conflict, the humanitarian situation has gradually improved, and in recent times, the economy has started recovering, with annual growth rates ranging from 13% in 2013 to 19% in 2015. The fisheries sector has a huge potential to contribute to poverty reduction and the overall development of the economy. However, the stock biomass of the country's fisheries has not been fully estimated in recent years, necessitating a comprehensive independent stock assessment to ensure effective management measures and foster resource sustainability (<http://spscrp.org/en/sierra-leone>). Despite this potential, the

sector faces challenges in enforcing well-drafted management rules, especially in areas of illegal, unreported, and unregulated fishing. Additionally, institutions for input supply, marketing, and establishing ownership of resources remain weak. Sierra Leone has abundant fish resources that could significantly contribute to the nation’s GDP (economic), food security, demand for fish, trade, income, and employment.

**2. Overview of fisheries resources**

Over 200 fish species have been identified in Sierra Leone and are classified into four categories: pelagic fish, demersal fish, Crustaceans, and Cephalopods. Tuna catches in exclusive economic zones (EEZ) are underexploited and, have huge potential. Hippos are the most important of the small pelagics, mainly for local consumption (Massaquoi, Roberts, and Tian, 2021).

**Diverse marine and freshwater resources**

The fisheries resources of Sierra Leone may be classified into four main categories: Pelagic,



demersal, crustacean, and etc. (Fig 1). Figure 1 shows the fish samples collected from the following locations and its coordinates are provided such as Funkia Wharf (8° 25' 54.98" N, -13° 17' 22.99" W), Old Wharf (8.4656° N, -13.2318° W), Tombo wharf (8°13'07.8"N - 13°05'53.6"W), Aberdeen Beach (8° 29' 59.99" N, -13° 16' 60.00" W), Lumley Beach (8.4742° N, 13.2835° W), Levuma Beach (8°26' 18" N, -13°16' 52" W).

**Figure 1:** Various fish and shrimp commonly found in the Sierra Leone; **A:** *Pseudotolithus senegalensis* **B:** *Penaeus notialis* **C:** *Drepane africana* **D:** *Galeoides decadactylus* **E:** *Exocoetus monocirrhus* **F:** *Lutjanus fulgens* **G:** Madeiran Sardinella **H:** *Lutjanus agenes* **I:** *Lutjanus dentatus* (Pictures of fish species taken by Christiana S. Johnson and Mary M. Barnette, 2024, at Lumley and Goderich Beaches, and the following markets: Bombay, Dovecot, Kingtom, and King Jimmy).

*Pelagic Fishery*

Pelagic fish stocks (Table 1) are classified into three main categories; true pelagics, semi-pelagics, (carangids), and large pelagics. Clupeidae or clupeids include *Ethmalosa fimbriata*, *Sardinella maderensis*, *Sardinella aurita*, *Ilisha africana*, and *Caranx hippos*) which are the most important small pelagics, mainly for local consumption. Common names: Krio (the local language in Sierra Leone without brackets and English names in brackets).

Table 1: The fisheries resources of Sierra Leone

<b>Pelagic fish stock (true pelagics)</b>				
<b>No</b>	<b>Common name</b>	<b>Scientific name</b>	<b>Family</b>	<b>Distribution</b>
<b>1</b>	Bonga	<i>Ethmalosa fimbriata</i>	Dorosomatidae	Atlantic Ocean: from Dakhla in Western Sahara southward to Lobito Bay in Angola
<b>2</b>	Herring (Round sardine herring)	<i>Sardinella aurita</i>	Dorosomatidae	Tropical and subtropical waters of western and eastern Atlantic Ocean
<b>3</b>	Flat herring	<i>Sardinella eba</i>	Dorosomatidae	Atlantic Ocean
<b>4</b>	Herring (Madeiran Sardinella)	<i>Sardinella maderensis</i>	Dorosomatidae	Atlantic Ocean
<b>5</b>	Lati (West African Ilisha)	<i>Ilisha africana</i>	Pristigasteridae	Atlantic coasts from Northern Senegal to south of Baie de Saint-Bras in Angola
<b>Pelagic fish stock - Carangidae fishery (Carangids)</b>				
<b>1</b>	Grey jack	<i>Caranx caballus</i>	Carangidae	Eastern Atlantic Ocean: subtropical waters, tropical waters of east Pacific
<b>2</b>	Pacific crevalle jack	<i>Caranx caninus</i>	Carangidae	Eastern Atlantic Ocean: subtropical waters, tropical waters of east Pacific
<b>3</b>	Cutmoney (Atlantic bumper)	<i>Chloroscombrus chrysurus</i>	Carangidae	West Africa coast from Mauritania to Angola
<b>4</b>	Pollock (False scad)	<i>Decapterus (Caranx) rhonchus</i>	Carangidae	Eastern Atlantic: Morocco to Angola
<b>5</b>	Cowreh	<i>Scomber (Caranx) carangus</i>	Carangidae	Eastern Atlantic: Morocco to Angola
<b>6</b>	Cowreh (Crevalle jack)	<i>Caranx hippos</i>	Carangidae	Eastern Atlantic, Tropical East Pacific
<b>7</b>	Atlantic horse	<i>Trachurus</i>	Carangidae	Eastern Atlantic: from

	mackerel	<i>trachurus</i>		Madeira, the Straits of Gibraltar, Canary, and Cape Verde Islands to South Africa.
<b>The Demersal Fishery (Sciaenidae – Sciaenids)</b>				
1	Ladyfish (Cassava croaker)	<i>Pseudotolithus senegalensis</i>	Sciaenidae	The west coast of Africa: from Morocco to Angola
2	Ladyfish (Lady longneck)	<i>Pseudotolithus typus</i>	Sciaenidae	Eastern Atlantic: Mauritania to Angola
3	Whiting/Casada fish (Law croaker)	<i>Pseudotolithus brachynathus</i>	Sciaenidae	West Africa coast from Mauritania to Angola
4	Gwangwa (Bobo croaker)	<i>Pseudotolithus elongatus</i>	Sciaenidae	Eastern Atlantic: Senegal to Southern Angola
5	Boe drum	<i>Pteroscion peli</i>	Sciaenidae	Eastern Atlantic: Senegal to Namibia
<b>The Demersal Fishery (Lutjanidae and Sphyraenidae)</b>				
1	Golden Africana snapper	<i>Lutjanus fulgens</i>	Lutjanidae	The west coast of Africa: from Morocco to Angola
2	Rose/red grouper African red snapper	<i>Lutjanus agenes</i>	Lutjanidae	Eastern Atlantic: Mauritania to Angola
3	Grey/black snapper (Goreen snapper)	<i>Lutjanus goreenis</i>	Lutjanidae	West Africa coast from Mauritania to Angola
4	Black grouper (African brown snapper)	<i>Lutjanus dentatus</i>	Lutjanidae	Eastern Atlantic: Senegal to Southern Angola
5	Kinni (Great barracuda)	<i>Sphyraena barracuda</i>	Sphyraenidae	Eastern Atlantic: Senegal to Namibia
<b>The Demersal Fishery – Sparidae Fishery (Sparids)</b>				
1	Red Snapper	<i>Dentex canariensis</i>	Sparidae	Eastern Atlantic: Cape Bojador, Western Sahara to Angola.
2	Angolan dentex	<i>Dentex angolenis</i>	Sparidae	Eastern Atlantic: Morocco to Angola.
3	Red Pandora	<i>Pagellus bellottii</i>	Sparidae	Eastern Atlantic: strait of Gibraltar to Angola.
4	Bluespotted seabream	<i>Pagrus caeruleostictus</i>	Sparidae	Eastern Atlantic: Portugal and Strait of Gibraltar to Angola.
<b>The Demersal Fishery – Polynemidae and Balistidae Fishery</b>				
1	Shinenose (Lesser African threadfin)	<i>Galeoides decadactylus</i>	Polynemidae	Eastern Atlantic: West African coasts from Canary Island; Morocco to Angola.

2	Royal threadfin	<i>Pentanemus quinquarius</i>	Polynemidae	Eastern Atlantic: Senegal to Angola
3	Spanish (Great African threadfin)	<i>Polydactylus quadrifid</i>	Polynemidae	Eastern Atlantic: Senegal to Angola
4	Gray triggerfish	<i>Balistes capriscus</i>	Balistidae	Western and Eastern Atlantic
<b>Tuna Fishery – Scombridae (Scombrids)</b>				
1	Bigeye tuna	<i>Thunnus obesus</i>	Scombridae	Atlantic, Indian, and Pacific: in tropical and subtropical waters.
2	Ship jack	<i>Katsuwonus pelamis</i>	Scombridae	Cosmopolitan in tropical and warm-temperate waters.
3	Bluefin tuna	<i>Thunnus thynnus</i>	Scombridae	Eastern Atlantic: Mauritania to South Africa.
4	Yellowfin	<i>Thunnus albacares</i>	Scombridae	Worldwide in tropical and subtropical seas.
5	West African Spanish mackerel	<i>Cybius tritor</i>	Scombridae	Eastern Atlantic: Canary Islands and Senegal to the Gulf of Guinea and Baía dos Tigres, Angola.
6	Cunene horse mackerel	<i>Trachurus trecae</i>	Scombridae	Eastern Atlantic: Morocco to Angola. Sometimes ranging south to northern Namibia
<b>Shark Fishery</b>				
1	Scalloped hammerhead	<i>Sphyrna lewini</i>	Sphyrnidae	Eastern Atlantic: western Mediterranean to Namibia
2	Smooth hammerhead	<i>Sphyrna zygaena</i>	Sphyrnidae	Widespread in temperate and tropical seas. Eastern Atlantic: British Isles to Côte d'Ivoire, including the Mediterranean.
3	Pigeye shark	<i>Carcharhinus amboienis</i>	Carcharhinidae	Eastern Atlantic: Nigeria. Indo-West Pacific: South Africa, and Madagascar.
4	Blacktip shark	<i>Carcharhinus limbatus</i>	Carcharhinidae	Eastern Atlantic: Senegal to Democratic Republic of the Congo.
5	Nurse shark/dogfish	<i>Ginglymostoma cirratum</i>	Ginglymostomatidae	East Atlantic Ocean: from Cape Verde to Gabon
<b>Ray Fishery (Batoids)</b>				
1	Skeete (Daisy stingray)	<i>Dasyatis margarita</i>	Dasyatidae	Eastern Central Atlantic: Senegal to Congo
2	Skeete (Common stingray)	<i>Dasyatis plastinaca</i>	Dasyatidae	East Atlantic and the Mediterranean and the Black Sea, from the North Sea to Angola.
3	Skeete	<i>Rostroraja alba</i>	Rajidae	Eastern Atlantic and

				southwest Indian Ocean (British Isles to Mozambique).
4	Skeete (Common guitarfish)	<i>Rhinobatos rhinobatos</i>	Rhinobatidae	Eastern Atlantic: southern Bay of Biscay to Angola, including the Mediterranean Sea.
5	Skeete (Lusitanian cownose ray)	<i>Rhinoptera marginata</i>	Rhinopteridae	Eastern Atlantic: southern Spain to Senegal, including the Mediterranean.
<b>Shellfish fishery</b>				
1	Pink shrimp	<i>Penaeus notialis</i>	Penaeidae	Atlantic Ocean: from Mexico to Brazil and Mauritania to Angola
2	Tiger shrimp Caramote prawn	<i>Penaeus kerathurus</i>	Penaeidae	Eastern Atlantic and the Mediterranean.
3	Deepwater rose shrimp	<i>Parapenaeus longirostris</i>	Penaeidae	Atlantic and the Mediterranean: Portugal to Namibia.
4	Lobster	<i>Panulirus spp.</i>	Palinuridae	Eastern Atlantic and the Mediterranean.
5	West African Mangrove oyster	<i>Crassostrea tulipa</i>	Ostreidae	Atlantic Ocean: From Mauritania to Angola
6	Rook oyster	<i>Crassostrea denticulata</i>	Ostreidae	Atlantic Ocean: From Mauritania to Angola
7	Crab	<i>Afrithelphusa spp.</i>	Deckeniidae	Endemic to the Upper Guinean forests of Guinea and Sierra Leone.

### The Demersal Fishery

Demersal fisheries play a pivotal role in the fisheries sector of Sierra Leone. This fishery targets highly valued demersal fish resources, such as sparids, sciaenids, albulids, haemulid serranids, polynimids, and ariids. These demersal resources have been subjected to increasing exploitation pressure for decades. The most dominant demersal fish resources are broadly classified into the following families:

- sciaenidae (Table 1), which comprises the croakers *Pseudotolithus senegalensis*, *P. typus*, and *P. brachynathus*;
- haemulidae, which comprises mainly *Pomadasys jubelini*, *Pomadasys rogers* and *Plectorhynchus macrolepis*;
- sparidae (Table 1), which is dominated by *Sparus caeruleostictus*, *Pagellus bellotii*, *P. coupe*, and *Dentex canariensis* (Otero, 1998);
- polynemidae (Table 1), the dominant species of which are *Galeiodes decadactylus*, *Polydactylus quadrifilis*, and *Pentanemus quinquarius*.

Other important demersal fish species (Table 1) in the Sierra Leone waters are Lutjanids, which are dominated by *Lutjanus goreensis*, and *L. dentatus*. They are located in the East Atlantic coast, from Morocco to Namibia (Lloris and Rucabado, 1990).

The Serranids are also largely represented by *Epinephelus aeneus* and *E. goreensis*. Other



species include *Pseudopeneus prayensis*, *Drepane Africana*, *Cynoglossus spp*, *Arius laticutatus*, and *A. heudeloti*.

#### Tuna Fishery

Sierra Leone is geographically located along the West Coast of Africa in the Eastern Central Atlantic, where there is an abundance of tuna and tuna-like species (Table 1), as well as other large pelagic species. Sierra Leone has been known as a country with enormous potential for tuna fisheries since the late 1950s. From that time, distant water tuna fishing vessels have exploited tuna and tuna-like resources in the EEZ.

The nationalities of the tuna fleet currently licensed in Sierra Leone include Spain, France, Belize, Ghana, Senegal, Panama, and Italy. The species exploited are mainly Yellowfin (*Thunnus albacares*), Bigeye tuna (*Thunnus obesus*) (Collette *et al.*, 2011), Skipjack (*Katsuwonus pelamis*), and Bluefin tuna (*Thunnus thynnus*) (Block *et al.*, 2001). The catches also constitute billfishes and other large pelagic species, such as the Atlantic white marlin (*Kajika thazard*), Atlantic sailfish (*Stiophorus albicans*), and swordfish (*Xiphias gladius*) that are fished directly or are incidental to the tuna catch.

#### Shark and Ray Fishery

The Shark fishery (Table 1) was introduced into Sierra Leone in 1974 by the Ghanaians (personal communication with a fisherman called, Saphian Cole (FAO, 2005). There was a rapid expansion in the shark trade afterward, and this expansion in the fishery sector brought in its wake the economic benefits of shark fins to African crew, then serving onboard these trawlers.

The shark species dominated (by weight) are the *Sphyrna* spp. (27 %) and the *Carcharhinus* spp. (52 %). In terms of occurrence by number (31 %), the species *Ginglymostoma cirratum* is very important in 10 commercial landings.

The ray fishery (Table 1) in Sierra Leone is exploited in the artisanal fishery. Shark and ray production is higher in finfish trawlers than in shrimp trawlers in industrial fisheries. Rays are batoids, whereas males dominate batoids. This engenders intense competition between male rays for a single female. Biologically, this is a disadvantage, as the continuous propagation of the population is undermined by the sex ratio observed in batoids. Other finfish species such as *Cynoglossus cynoglossus*, *Galeoides decadactylus*, and *Drepane africana*, are also important in the fishery industry.

#### Shellfish fishery

The shrimp fishery (Table 1) is one of the most important fisheries in Sierra Leone. There are three most commercially exploited penaeid shrimp in Sierra Leone waters. They include *Penaeus notialis* (pink shrimp), which is the most dominant species caught in Sierra Leone, followed by *Penaeus kerathurus* (tiger shrimp) (Kevrekidis and Thessalou-Legaki, 2011) and *Parapenaeus longirostris* (Deepwater rose shrimp), which are less abundant and under-exploited. *Parapeneopsis atlantica* (white shrimp) has market potential.

Despite the importance of the shrimp fishery in Sierra Leone, it has major ecological and socioeconomic problem that it is characterized by high bycatch rates (more than four-fold of the shrimp catch) mainly due to the indiscriminate use of illegal fishing gears in nursery and spawning areas. Eayrs (2007), indicated that the shrimp trawlers deliberately target finfish during the day, making bycatch a target fishery. Fishing of snails, lobsters, oysters, cockles, and a bit of octopus occurs in Sierra Leone. Lobster fishing is extensively performed at Lumley and Lakka Beach by local fishermen.

These tables do not contain all fishery stocks in Sierra Leone. There are other species of fin and shellfish that are fish in minimal amounts. Fish stocks include crabs, cockles, snails, and octopuses.

### Description of key fish species and their ecological roles

Each species within an aquatic species typically has a distinct purpose, even though its quantity allows for characterization (Table 2). Therefore, ecosystem functioning can differ according to its unique structure. An organism, whose existence is essential for preserving the diversity and structure of ecological ecosystems, is referred to as a keystone species. According to two primary factors, key predators and key preys, their extinction has the potential to significantly alter ecological processes and the unique makeup of communities. To better understand how species work in ecological systems, ecologists have been identifying which species are dominant in feeding networks. However, we have also come to understand that fish can contribute indirectly by recycling their dietary components.

Table 2: Key fish species and their ecological roles

No.	Scientific name	Description	Ecological role
1	<i>Ethmalosa fimbriata</i>	0 dorsal spine, 16-19 dorsal soft rays, 0 anal spines, 19–25, anal soft rays: 19-25, 40-44 vertebrae. Body fairly deep, compressed, scutes present along the belly.	It feeds principally on phytoplankton, chiefly diatoms, filtered by the fine gill raker sieve.
2	<i>Sardinella aurita</i>	0 dorsal spines, 17-20 dorsal soft rays, - 0 anal spines, 16-18 anal soft rays, 47-49 vertebrae. Elongated body, but sometimes a little compressed; belly rather rounded, but with a distinct keel of scutes.	It feeds mainly on zooplankton (copepods and larvae of mysids).
3	<i>Sardinella maderensis</i>	0 dorsal spines, 18-23 dorsal soft rays, 0 anal spines, 17-23 anal soft rays, 44-48 vertebrae. Elongated body, but variable in depth, belly fairly sharply keeled; 7 - 166 lower gill rakers.	It feeds on a variety of small planktonic invertebrates, also fish larvae and phytoplankton
4	<i>Ilisha africana</i>	0 dorsal spines, 14-17 dorsal soft rays, 0 anal spines: 0; 45-50 anal soft rays, 42-43 vertebrae. Body moderately deep, compressed, belly with a sharp and serrated keel of scutes from gill opening to the anus.	It feeds on small planktonic animals (small fish and crustaceans).
5	<i>Chloroscombrus chrysurus</i>	9 dorsal spines, 25-28 dorsal soft rays, 3 anal spines, 25-28 anal soft rays. Compressed body and deep (depth comprised from 2.3 to 2.8 times in fork length).	They feed on fish, cephalopods, zooplankton, and detritus.
6	<i>Decapterus (Caranx) rhonchus</i>	9 dorsal spines, 28-32 dorsal soft rays, 3 anal spines, 25-28 anal soft rays. Elongate body and slightly compressed, its depth comprised from 3.8 to 4.4 times in fork length.	Feed on small fish and invertebrates.
7	<i>Sphyraena barracuda</i>	6 dorsal spines, 9 dorsal soft rays,	Feeds on fish,

		2 anal spines, 8 anal soft rays. Has large body, large eyes; teeth erect and contiguous; no gill rakers	cephalopods, and sometimes on shrimps
8	<i>Trachurus trachurus</i>	9 dorsal spines, 30-36 dorsal, 3 soft rays, 3 anal spines, 24-32 anal soft rays. Bluish green, grey, or black and silvery white. Lateral scales are tall and keeled. Gill is covered with a distinct black spot.	They feed on fish, crustaceans, and cephalopods.
9	<i>Pseudotolithus typus</i>	10 dorsal spines, 28-32 dorsal soft rays. Dorsal fin with 9 spines in the 1st part and 1 spine and 28-32. Gill rakers are short, about as long as gill filament.	Feeds mainly on small fishes and crustaceans
10	<i>Pseudotolithus elongatus</i>	11 dorsal spines, 29-35 dorsal soft rays, 2 anal spines, 6-7 anal soft rays. Medium-sized elongated fish, and laterally compressed. Head and snout short and large eyes.	They feed on (juvenile) fish, shrimps, and other crustaceans.
11	<i>Lutjanus dentatus</i>	10 dorsal spines, 13-14 dorsal soft rays, 3 anal spines, 8 anal soft rays. The body is relatively deep, the head conical, and slightly rounded, its dorsal profile curving gently.	Feed on fishes and crustaceans.
12	<i>Cynoglossus cynoglossus</i> – sole fish	0 dorsal spines, 95-102 dorsal soft rays, 0 anal spines, 72-78 anal soft rays: 72 - 78. The dorsolateral line usually has irregular cross bands on the body. Eyed-side lower jaw with crenulate fleshy ridge	Feeds on benthic invertebrates
13	<i>Lutjanus agenes</i>	10 dorsal spines, 13-14 dorsal soft rays, 3 anal spines, and 8 anal soft rays. Head pointed, gap of mouth wide, Body relatively deep; dorsal head profile straight Maxilla extending nearly to mid-eye level	They feed mainly on fishes and crustaceans.
14	<i>Lutjanus goreenis</i>	10 dorsal spines, 14 dorsal soft rays, 3 anal spines, 8 anal soft rays. Body stocky, relatively deep, head pointed dorsal profile of forehead steep, and large eyes.	They feed mainly on fishes and bottom-dwelling invertebrates.
15	<i>Sphyrna lewini</i>	0 dorsal spines, 0 dorsal soft rays, 0 anal spines, 0 anal soft rays. Has a large, slender body; broad,	Feed mainly on teleost fishes, cephalopods, lobsters, shrimps, crabs,

		narrow-bladed head, arched anterior margin with prominent median indentation.	sharks, and rays.
16	<i>Carcharhinus amboienis</i>	0 dorsal spines, 0 dorsal soft rays, 0 anal spines, 0 anal soft rays. A massive shark with a thick-set head, small eyes, and large, triangular, saw-edged upper teeth.	Feed on pelagic and demersal bony fishes, sharks and rays, squid, shrimps, cuttlefish, octopi, and lobsters.
17	<i>Ginglymostoma cirratum</i>	0 dorsal spines. Moderately long barbels, nasoral grooves present, mouth well in front of eyes, precaudal tail shorter than head and body, dorsal fins broadly rounded.	Feed on spiny lobsters, shrimps, crabs, sea urchins, squids, octopi, snails, and bivalves.
18	<i>Galeoides decadactylus</i>	9 dorsal spines, 13-14 dorsal soft rays, and 9-10 short detached pectoral filaments, body moderately elongate and compressed.	Feed on benthic invertebrates.
19	<i>Cybiium tritor</i>	15 -18 dorsal spines, 0 dorsal soft rays, 17-20 anal soft rays, 46-47 vertebrae. Small and bifid Interpelvic and the body is covered with small scales	Enters coastal lagoons and feeds on clupeids, particularly <i>Ethmalosa fimbriata</i> .
20	<i>Thunnus obesus</i>	13-14 dorsal spines, 14-15 dorsal soft rays, no anal spines, 14 anal soft rays, and 39 vertebrae. It has a robust, fusiform body, slightly compressed from side to side, and 23-31 total gill rakers.	Feed on a wide variety of fishes, cephalopods, and crustaceans during the day and at night
21	<i>Katsuwonus pelamis</i>	14-16 dorsal spines, 14-15 dorsal soft rays, 0 anal spines, 14-15 anal soft rays, and 41 vertebrae. Body fusiform, elongate and rounded; teeth small and conical, in a single series; gill rakers on first-gill arch numerous,	Feed on fishes, crustaceans, cephalopods, and mollusks; cannibalism is common.
22	<i>Exocoetus monocirrhus</i>	0 dorsal spines, 12-14 dorsal soft rays, 0 anal spines, 12-14 anal soft rays, 12 – 14. Body dark iridescent blue above, silvery white below.	Feed mostly on crustaceans and other planktonic animals.
23	<i>Lutjanus dentatus</i>	10 dorsal spines, 13-14 dorsal soft rays, 3 anal spines, and 8 anal soft rays. Body relatively deep, head conical, slightly rounded, its dorsal profile curving gently	Feed on fishes and crustaceans.
24	<i>Scomber (Caranx)</i>	8-9 dorsal spines, 20 - 21 dorsal	Feed on several fishes

	<i>carangus</i>	soft rays, 2 anal spines, 16 - 17 anal soft rays. Elongated and compressed body with the dorsal profile.	and invertebrates like prawns, shrimp, crabs, and stomatopods.
25	<i>Dentex canariensis</i>	12 dorsal fin spines, 9 -10 soft rays, 19-22 gill rakers in total, 3 anal fin spines, 8- 9 soft rays. Body oval, rather deep and compressed.	Adults feed on fish, crustaceans, and cephalopods while the young feed on plankton
26	<i>Polydactylus quadrifid</i>	9 dorsal spines, 12-13 dorsal soft rays, 3 anal spines, 11-12 anal soft rays. The pectoral fin with 4 threadlike filaments and it is inserted very low on the body.	Feeds on crustaceans and fishes
27	<i>Dasyatis margarita</i>	130 vertebrae. Pearl spines are always present and very large; denticles on the dorsal surface of the disc are smooth, and restricted to the middle portion.	Feeds on shrimps, crabs, bivalves and annelids
28	<i>Rhinoptera marginata</i>	Disc transversally lozenge-shaped, about twice as wide as long, with sharply angled outer corners. Head elevated from disc, with eyes on sides of the head.	Feeds on bottom-living mollusks, crustaceans and fishes

### 3. Fishing practices and techniques

The fisheries sector of Sierra Leone expanded enormously in the 1980s, with the introduction of highly technological and efficient industrial fishing vessels. During this period, the industrial fishing fleet constituted over 300 vessels. Combined with artisanal efforts, this expansion led to a peak total fish production of nearly 250,000 metric tons. The catch was primarily dominated by small pelagics, including species such as *Trachurus* spp., *Sardinella* spp., and *Ethmalosa fimbriata*.

#### Traditional and Modern Fishing Methods

The fishing industry in Sierra Leone characterized by a dualistic structure: industrial and artisanal fisheries. The artisanal industry is further divided into (a) marine artisanal, and (b) inland artisanal and aquaculture. Fish are an important part of the diet in Sierra Leone, supplying approximately 80% of the total animal protein consumption.

##### *Industrial fishery*

Industrial fishery is the backbone of a country's export trade. Industrial fishing operations are mainly conducted through joint ventures with foreign-owned vessels, including shrimp and finfish demersal trawlers. Purse-seiners and longliners for tuna also operate in Sierra Leone waters during the appropriate fishing seasons. Currently, the nationalities of industrial fishing vessels are mainly China, Korea, Greece, and Spain.

Fishing gears are valuable asset in the industrial fishery. A new method of associating global marine catch statistics with fishing gears has enabled the creation of maps detailing the changing use of fishing gears, such as trawls and dredges, from the 1950s to the present. These gears, often associated with high impacts on benthic communities, are used to catch a wide range of demersal fish, mollusks, fish, and crustacean catch (Watson *et al.*, 2006).

The industrial fishery operates mostly in deep waters with an average depth of 30 meters,

beyond the Inshore Exclusion Zone, which extends up to six nautical miles from the baseline of the EEZ of Sierra Leone. The foreign national fishing fleet, including fish trawlers, shrimpers, tuna purse seiners, support vessels, carriers, dominate industrial fisheries. The gross registered tonnage (GRT) of shrimp trawlers generally ranges from 100-150 tons, while finfish trawlers range from 150-600 tons.

However, Monitoring Control and Surveillance (MCS) are very weak, posing significant challenges for the improvement of the industrial fishery in Sierra Leone. Illegal fishing continues to impact economic gain, driven by significant incentive (Le Gallic and Cox, 2006; Sumaila *et al.*, 2006) and the ability to operate without detection (Andrews-Chouicha and Gray, 2005).

#### *Artisanal fishery*

The artisanal fishery sector in Sierra Leone plays a pivotal role in the country's fish production. It is characterized by the use of approximately 8,000 canoes, with around 8% equipped with outboard engines. These canoes employ various fishing gears, including hooks and lines, surface or bottom sets, drifts, and ring nets. Artisanal fisheries contribute significantly to the national fish landings, with their share rising from an average of 21% between 1990 and 1992 to 73.4% during the civil unrest period from 1995 to 2000, due to the decline in industrial fishery activities. The sector includes a variety of canoes, such as dugouts and planked boats, and employs a wide range of fishing gears like cast nets, ring nets, driftnets, set nets, beach seines, pots and traps, fencing, and hooks and lines.

A 2018 frame survey recorded 12,000 active fishing canoes, an increase of 2,000 from the 10,000 canoes reported in 2011. The primary small pelagic species landed include golden sardines, Carangidae, Scombridae, barracuda, horse mackerels, and, to a lesser extent, anchovies and small jacks.

The artisanal subsector is the dominant contributor to Sierra Leone's total annual fish production. Inshore multiple stock fisheries are exploited using various gears (gillnets, cast nets, beach seines, trawls, purse seines, ring nets, traps, and hooks), operated by both artisanal and industrial fishing boats. Before the introduction of trawlers by Italians in 1955, fishing in Sierra Leone was purely artisanal. Today, the artisanal sector accounts for more than 80% of national fish landings.

The data used in this report are recent, collected through a combination of online sources, the Ministry of Fisheries and Marine Resources, and published books. Fish stock images are original and were gathered by the authors based in Sierra Leone during the research. This data is publicly available and aims to raise awareness, identify areas for improvement within the fishery ministry, and inform the global community about Sierra Leone's rich fish stock. There are no conflicts of interest in this research.

#### *Inland Fishery and Aquaculture*

Inland fisheries in Sierra Leone operate in rivers, lakes, floodplains, and swamps. The main river system includes the Great Scarcies, Little Scarcies, Rokel, Jong, Moa, and Sewa. These fisheries primarily used dugout canoes of diverse sizes, which are mainly propelled by paddles and sails. The type of freshwater species found depend on the specific part of the river, such as the headwaters, upper reaches, middle reaches, lower reaches, and estuaries).

Notable species in these freshwater systems include: *Momyrus rume*; *M. tapirus*; *Hemichromis fasciatus*; *Talipia beutlkoferi*, *Barbus socratus*; *Raiamis scarciensis*; *Auchenoglanis occidentalis*; *Chrysichthys jahnelsi*; *Synodontis thysi*; *Marcursenius mento*; *Byrcinus longipinis*; *Synodontis thysi*; *Claris leaviceps*; *Malapterurus electricus* and *Lates niloticus*.

In 2017, Sierra Leone experienced severe natural disasters, including heavy mudslides and flooding, which over 500 fatalities and displaced hundreds of families. Sierra Leone heavily relies on marine capture fisheries, as fish is the main source of animal protein for about three-

quarters of the population. However, many targeted fish stocks are in decline. Notably, stocks of Bonga (*Ethlamosa fimbriata*), Snappers (Lutjanidae), Groupers (Epinephelidae), Shrimp (Caridea) and Herring (*Clupea harengus*) are fully exploited and require careful management to ensure sustainability (Okeke-Ogbuafor *et al.*, 2021).

Aquaculture in Sierra Leone is primarily practiced in inland valley swamps and wetlands. The natural environment is suitable for aquaculture, particularly for aquaculture, particularly for the culture of tilapia and catfish species. The development because of its natural. Despite some progress with support from the FAO, World Fish, research institutions, and international agencies, the sector remains largely untapped. Fish farming is still in a rudimentary stage, and the enabling environment for commercial fish farming is inadequate, leaving significant potential for development.

### **Impact of fishing practices on the environment and sustainability**

The fishery resources of Sierra Leone have faced significant fishing pressure for decades, both from foreign commercial industrial fishing vessels and the artisanal fishing fleet. Previous surveys conducted by MFMR in the 1980s, indicated a decrease in the biomass of key commercially exploited fish species (MFMR, 2016).

In 2006 and 2007, the Norwegian fisheries research vessel, R/V Dr. Fridtof Nansen conducted surveys in Sierra Leone waters under the Guinea Current Enormous Marine Ecosystem (GCLME) regional project. These surveys estimated a standing stock of approximately 300,000 metric tons, with pelagic species constituting around 90% of the estimated biomass. Similarly, from 2008 to 2011, the Senegalese research vessel R/V Itaf Deme conducted a comprehensive fish stocks assessment survey in Sierra Leone waters for three years by the under the EU-funded project, Institutional Support to Fisheries Management.

The results of these surveys indicated signs of over-exploitation. They showed increased exploitation of juvenile sardinella by licensed foreign industrial trawlers, which has significant social and economic implications, especially for artisanal fishermen who directly compete for the same resources. The following subsections will highlight the exploitation status of specifically targeted fish stocks that are of high commercial importance to Sierra Leone's fisheries sector.

The sustainable development of fisheries in Sierra Leone faces several constraints:

- high initial input cost of entry and operation;
- poverty status of the fishermen;
- poor knowledge of fishing technology among Sierra Leonean fishermen;
- high foreign national participation in the fisheries;
- poor knowledge of stock size;
- inadequately trained personnel in the identity of various species;
- lack of data on export (fins and meat) from the artisanal fisheries;
- poor biological information on distribution, growth, reproduction, and recruitment;
- aggregation of fish species in statistical data collection by the Ministry;
- difficulty in monitoring the fisheries due to the highly migratory nature of the fishermen;
- lack of specific legislation adopted for the management and conservation of fish;
- destruction of fishing nets by industrial trawlers.

### **4. Regulatory framework and management measures**

The Fisheries Management Mandate in Sierra Leone is responsible for the management, development, and conservation of the fisheries resources. This mandate covers marine, inland, and aquaculture fisheries and is currently under the purview of the MFMR. The Fisheries Management and Development Act of 1994, along with the subsequent Fisheries Regulations

of 1995, provides the legal framework for the management, planning, and development of the fisheries and fishing industries of Sierra Leone. These legislative measures are designed to ensure the sustainable use of fisheries resources, promoting both conservation and economic development within the sector.

### **Analysis of existing policies and regulations**

Institutionally, the 1963 Fisheries (Amendment) Act, the 1988 Fisheries Development and Management Act and the 1994 Fisheries Development and Management Decree affirms that: “the exclusive management and control over fish, fisheries and other aquatic resources within the fishery waters shall be vested in the government.” The main fisheries policy is the 2016 Policy for Fisheries and Aquaculture in Sierra Leone (hereafter referred to as "Fisheries Policy"), which aims at balancing ecologically sustainable fisheries, economic viability, secure tenure rights and social stability through responsible governance procedures.

In practice, management responsibilities have been vested in the MFMR since 1994 (before this with a Department of Fisheries located within the Ministry of Agriculture, Forestry and Marine Resources). While strategies for the sector were also laid down in the 1994 Decree, the civil war ensured there was no “proper physical enforcement of legislation”, or effective maritime surveillance in the country’s economic exclusion zones (EEZ) between 1993 and 2003.

In support of the Act, the Fisheries Policy of Sierra Leone was enacted in 2003. The Exclusive Management and Control of fisheries and other aquatic resources within the fishery waters shall be vested in the government, and this management and control may be exercised by them directly or through the Minister, Director of Fisheries, or any other authorized officer. The Fisheries Sector Policy Goal Government Policy in its Fisheries Development Programme focuses on the following broad objectives: to improve national nutrition and food security through responsible fishing and the reduction of spoilage and wastage, to increase employment opportunities, to raise the socio-economic status of the people in the fisheries sector, including women, and to improve the skills of fishing communities and increase export earnings in industrial fisheries (FAO, 2024).

Regulations Governing Fisheries Access to industrial fishing is regulated by a licensing system as stipulated in the 1994 Fisheries Management and Development Act. Similarly, there is a licensing system that restricts access to artisanal fisheries but has largely remained ineffective due to the scattered nature of the sector. For example, the cost of a license for shark fishing in Sierra Leone is US\$ 500. However, there are no regulations on mesh sizes, close seasons, and fishing efforts in the shark fishery.

### **Discussion of conservation and management strategies**

The overall objective of this fisheries management plan is to create a profitable fisheries sector that contributes significantly to socio-economic development through sustainable management and utilization of fisheries resources, while also conserving the environment. In the medium term, the management plan will set levels of sustainable exploitation for targeted fisheries, and create rights and allocation mechanisms for such fisheries.

However, the Director of MFMR was also required to establish committees of stakeholders, including artisanal fishers, in order to: identify coastal fisheries resources; assess the rate of their exploitation; introduce measures that would support small-scale fishers; and, based on estimates of available fish resources, decide the quantity of stocks to be made available to industrial fishers. However, the failure of MFMR to manage the fisheries successfully led to the 2004 Local Government Act which transferred the management of the SSF sector to local councils under the supervision of the MFMR (Thorpe *et al.*, 2009).

*Objectives and Management Strategies*



This management plan seeks to achieve the following management objectives:

- to regulate fishing efforts by fishing fleets in the industrial, semi-industrial, and artisanal sub-sectors to a level that will ensure sustainable exploitation of fish stocks at maximum economic yield (MEY);
- to improve the status of target fish stocks within biologically acceptable levels;
- to protect aquatic and marine habitats and biodiversity;
- to improve the knowledge base on the status of the fish stocks;
- to effectively implement the fisheries legislation and regulations;
- to enhance value addition and export opportunities;
- to strengthen stakeholder engagement in the decision-making process;
- to ensure compliance with regional and international fisheries instruments;
- to provide for food security through fish supply;
- to provide for a profitable national industry;
- to ensure effective service delivery of the MFMR.

#### *Scope and Operation of the Management Plan*

The plan covers a period of five years from September 2020 to August 2025. To successfully implement the plan, an annual work plan will be hived every year during the 5 years. They will be subjected to review by the MFMR in collaboration with the Scientific, Economic, and Technical Committee (SETC) and research institutions, including IMBO, based on any major changes in the exploitation state of the fish resources.

During this period, an effective data collection system will be established, and the relevant data collected will be analyzed by the Statistics Unit of the MFMR in collaboration with IMBO (Sparre, 2000). The Ministry of Fisheries and Marine Resources will prepare annual reports on the status of the resources and progress on the key performance indicators (KPIs) of the Management Plan, which will be presented to the SETC for discussion and approval, and thereafter shared with relevant stakeholders.

#### *Management Measures and Alternatives*

Aside from external income support, maximizing the value of catch is a common goal and an intuitive way to increase fishing incomes without necessarily increasing catch (Pascual-Fernández *et al.*, 2019). These strategies can act at various steps in seafood supply chains and do not necessarily require high capital investments on the part of the fishers, which may of course hinder their adoption. Instituting frameworks for management of the fish stock in Sierra Leone, these measures and recommendations in this section will seek to restore the stocks as a whole and the ecosystem wellbeing of the marine environment: reduction of fishing efforts, moratorium on licensing of additional fishing vessels implemented, seasonal closed season implemented, fishing restricted time, trawling hours restricted, reduction of illegal fishing in the artisanal sector, capping of fishing trawlers number of legal fishing nets, introduction of selective devices and implementation of fisheries observer program.

The Fisheries Management Plan of Sierra Leone for the marine fisheries sector 2020-2025 seeks to achieve management objectives relevant to the EAF, such as improving the status of target fish stocks within biologically acceptable levels, protecting aquatic and marine habitats and biodiversity, improving the knowledge-base on the status of the fish stocks, and strengthening stakeholder engagement in decision making process (Nakamura *et al.*, 2023).

## **5. Current challenges in sierra leone's fisheries**

### **Identification of key challenges**

A key challenge affecting the fishery industry is the excessive exploitation of fish species near the coast. As a result, the increasing pressure of fishing efforts in capture fisheries has considerably increased fishing mortality over the years. Fisheries also faced another threat, mainly caused by anthropogenic activities, which have negative implications for the health of

aquatic and marine ecosystems.

Another threat to the sustainable management of fisheries resources is the limited knowledge of the current status of fish stocks. A current challenge to improved development planning is the lack of reliable and standardized information on fishing profits and their distribution (Béné *et al.*, 2007; Teh *et al.*, 2020), which should be prioritized in global initiatives, such as the nascent UN Decade of Ocean Science that has focused on important but insufficient ecological and social data collection (Singh *et al.*, 2021).

In addition, the Statistics Unit of the Ministry, which monitors the performance of both the input and output of the fisheries by collecting and analyzing daily catch and effort data, needs considerable support to improve the fisheries data collection system that will generate quality and reliable fisheries and socioeconomic data. Anthropogenic activity is challenging. The indiscriminate removal of vegetation cover, such as mangrove plants as wood for fish smoking, boat building, rice farming, salt mining, and housing, has degraded spawning and nursery habitats, thereby causing possible stock recruitment failure or disturbance in stock recruitment. Continuous pollution of the marine environment with plastics and heavy metal chemicals from runoffs can have long-lasting negative impacts on the flora and fauna of breeding and nursery areas (Davies *et al.*, 2024).

#### *Overfishing*

This is largely due to the indiscriminate use of destructive fishing methods and illegal fishing nets in spawning and nursery areas by industrial, semi-industrial, and artisanal fishing fleets. Additionally, the average number of active trawling hours in industrial fisheries has been increasing progressively recently. This has contributed to the overexploitation of the most valuable fish stocks. Fish stocks undergo both recruitment and growth overfishing (FAO, 2021).

Recent estimates by the CECAF Scientific Sub-Committees Demersal Working Group (South) in 2017 have recommended an overall reduction in fishing effort and catch, as most commercially exploited species in the region are either fully exploited or over-exploited. Independent analyses conducted by Showers (1999), and Eayrs (2007) indicated that the harvest capacity had surpassed a sustainable exploitation level. In other words, the shrimp resources are either fully exploited or overexploited.

#### *Illegal fishing*

Economic analysis of the industrial fishery shows that the fishery does not deliver the expected benefit to the national economy. The payment of license fees, royalties, transshipment, and landing fees, even at the increased rates imposed in the past year, does not compensate for the costs of overfishing and the prevention of profitability by the national industry, because there are countless local fishermen and foreign fleets on the shores of Sierra Leone. Some perform their operations at night, and there have been limited night sea patrols by sea guards and other agencies. MCS is often bound with country's indicators such as governance and corruption (Standing, 2006), which are very weak in Sierra Leone. Poor governance and high corruption combined with high monitoring costs pose a serious concern on the sustainability of West African countries' efforts to combat illegal fishing.

The number of vessels spotted fishing illegally, or estimated, was reported at 30 for 2011, 10 in 2012 (Finch, 2016), 7 in 2014 (NOAA, 2015), and 80 in 2015 associated with the Ebola crisis. The Ebola crisis along with governance issues related to the cancellation of the World Bank (2016) project, a major contributor to the increase in MCS in 2012 and 2013, prompted low to virtually no monitoring after 2014. We interpolated the number of boats between 2012 and 2014 and then multiplied by a minimum CPUE of  $446 \text{ t}\cdot\text{boat}^{-1}\cdot\text{year}^{-1}$  for the industrial fleet operating in Sierra Leone (Seto *et al.*, 2015)

#### *Climate change*

The West African climate has evolved in recent decades according to the latest

Intergovernmental Panel on Climate Change report, recognizing atmospheric and oceanic warming with high certainty in all 34 FAO subregions and on the contiguous continent (Niang *et al.*, 2014; Pörtner *et al.*, 2014).

Ocean warming in fisheries is caused by an increase in the dominance of warmer water species. Climate change has induced changes in potential catch and species composition, which inherently have symptoms similar to over-exploitation. Therefore, there have been negative impacts on the economic and social sectors of fisheries in Sierra Leone. Both artisanal and industrial sectors may adapt to these changes mainly through the expansion of fishing grounds, which increases operational costs.

## 6. Economic and social impacts

State failure can have a traumatic effect on both life and livelihoods. In the case of Sierra Leone, the 10-year civil conflict had a devastating social and economic impact; over 2 million of the total population of barely 6 million at that time were displaced. Over 20,000 lives were lost, and many suffered serious physical injuries, not psychological trauma. Common arguments about the relationship between fisheries and poverty allude to over-capacity, poor regulations, and a simple lack of other economic opportunities that all lead to general over-exploitation and reduced incomes (Gutiérrez *et al.*, 2011).

The eleven-year civil war affected the economic and social aspects of the fishery industry. Fishers were in a more fortuitous position than their agricultural counterparts were. This caused fishers to relocate their vessels to safer harbors (internally and in neighboring Guinea) to protect both themselves and their livelihoods.

The annual economic loss caused by illegal and unreported fishing was estimated by multiplying the estimated illegal and unreported catch by the ex-vessel price. Ex-vessel prices were obtained from the Sea Around Us ex-vessel price database for 2010 (Swartz *et al.*, 2013) and converted to 2015 USD using Consumer Price Index extracted from the World Bank database ([www.worldbank.org](http://www.worldbank.org)). Hence, rigid measures are needed to ensure the fishery sector continues to contribute to the economy of the nation and reach its potential.

## Evaluation of the economic contributions

The fishery sector plays a critical role in the economic development of Sierra Leone. Given the foregoing and considering the importance of sparids to the socio-economic development of the country, the Ministry has proposed specific management measures to rebuild the stock and its ecosystem.

Marine fisheries are essential for the subsistence, cultures, and livelihoods of people in coastal nations around the world (Allison *et al.*, 2020). The fishery sector is estimated to provide employment and a source of livelihood for over 500,000 people, mainly in coastal communities. Fish is the most important source of animal protein for the majority of the population.

Annual fish exports are valued at USD 2.5 million and fishing license fees amount to USD 2.5 million per year. In terms of domestic revenue collection by the Government of Sierra Leone, the fisheries sector contributed USD 34 million (1 percent of the total revenue) in 2014, as shown in Table 3. This represents a doubling of revenue collected in 2013.

Table 3: Sierra Leone: domestic revenue collection (Source: Government of Sierra Leone, Accountant General's Department, Annual Report, 2014)

Area	Amount of Revenue in Le (million)	Amount of Revenue in USD (million)	Amount of Revenue in %
Road vehicles	87,616	199	4

Other Departments	64, 642	147	3
Fisheries	14, 929	34	1
Minerals	209, 413	476	9
Goods and Service Tax	459, 095	1043	21
Customs and Excise	506, 816	1152	23
Income Tax Total	895, 681	2036	40
Total	2,238,192	5087	100

Based on recent work undertaken by the New Partnership for Africa's Development (NEPAD), an assessment was made of the potential contribution of one of the country's major natural resource sectors, fisheries, to Future economic recovery. It was confirmed that the Sierra Leone fish resources had an mated capitalised economic value of USD 735 million, and could potentially make an increased contribution to GDP under suitable conditions, above the current estimated level of 10 per cent. However, our results also show that an overall "readiness assessment" score of 41/100, the sector is unlikely to realise its full potential unless a number of specific areas are adressed (based on an analysis valid up to January 2016). These include improvements in the fisheries industry. economic assessment, the upgrading of the fisheries governance and management framework, and the establishment of a fisheries development strategy and implementation plan to channel future investments and interventions in an appropriate sequence. Particular attention should be

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potentially make an increased contribution to GDP under suitable conditions, over and above the current estimated level of 10 percent.

Fish and other aquatic products are critical for economic activity, export earnings, and employment in Sierra Leone as well as for food security and nutrition. The fisheries sector is one of the main contributors to the national economy, accounting for approximately 10% of GDP (Neiland et al. 2016). Fish is the most important animal-source food in the diets of Sierra Leoneans, providing approximately 80% of animal protein intake, and which is important for nutrition, especially in a country that rank very low globally in poverty and nutrition indicators, which is particularly concerning for women and young children (Pasqualino *et al.*, 2016).

### **Examination of the sector's role in supporting livelihoods and communities**

The fishing sector continues to sustain its livelihoods and communities. Many women in the fishing industry buy and sell raw and fresh fish stocks to sustain their lives and family and industrial fishing leads to a drop-in fish supplies for communities, putting jobs at risk and causing irreparable damage to the seabed, prompting many to fear the future. They also dried the fish for commercial use. It is estimated that the fisheries sector in Sierra Leone employs over 500 people in coastal communities (Neiland *et al.*, 2016). The majority of fish consumed within Tonkolili District comes from artisanal fisheries in the Western Rural Area District.

At wharves across the Freetown Peninsula in Sierra Leone, local fishers say, in recent years, it has become harder to get a good catch. They blame foreign trawlers for overexploiting their fish stocks. Before, local fishermen experienced good catches, but now, it is a different story. This has affected livelihoods and communities. Sierra Leone's Ministry of Fisheries and Marine Resources states that it has systems meant to curb illegal, unreported, and unregulated fishing; however, enforcement remains a challenge.

### **7. International collaboration and agreements**

Regional collaboration in the management of fishery sector strategies to foster international collaboration. It is ongoing, and this has influenced many nationalities to conduct business with the Ministry of Marine and Maritime.

This is done to promote data exchange programs with countries in the sub-region, exchange visits of scientists between countries in the sub-region, share knowledge and scientific information on the fish stock, and promote adherence to international action plans.

### **Overview of engagement with international fisheries organizations**

Historically, Sierra Leone's industrial fisheries date back to 1955, when Italian companies introduced trawlers into local waters. The fishing effort gradually increased until a series of fishing agreements with the USSR allowed a large Soviet fleet of trawlers, purse seiners, and factory vessels to enter the national waters).

The numbers peaked in 1987 when 288 vessels were licensed (144 demersal trawlers, 84 shrimpers, and 60 purse seiners). By the mid-1990s, with demersal resources progressively fished and the collapse of the Soviet Union, production fell back to around 65,000 tons (principally small pelagics). Other nations exited national waters internally.

With the decline of marine resources in the North Atlantic, North Sea, and Mediterranean Sea, the activities of European fishermen have diversified and expanded toward the center of the Atlantic. Since the 1980's the West African countries have benefited from this development. Their economies are based on foreign currencies.

For several years, these indicators have proliferated and show that marine and coastal resources are exploited to the maximum extent. In addition, catches have experienced declines and forecasts of stock growth are negative. Faced with the challenges presented by

the need to develop a coherent framework for the return to a more sustainable management of fisheries resources in West Africa, in 2002 the SRFC endowed herself with a strategic action plan (2002 – 2010 SAP). This plan is part of a long-term vision and allows for better visibility of actions to be undertaken for the management of fisheries at the sub-region level.

### **Assessment of agreements impacting fisheries resources**

As of 2016, 156 foreign vessels were licensed to fish in Sierra Leonean waters. The government says these boats bring value to the country by paying taxes and supplementing the artisanal catch, which accounts for approximately 65% of Sierra Leone's total annual on-the-books fish production. Without foreign fleets, fish demand is likely to exceed supply. However, artisanal fishers say they are on the wrong side of a power imbalance: in disputes over collisions or encroachment into prohibited fishing zones, it can be hard to get foreign boats to pay damages.

There are agreements with many foreign countries and deals have been successful; the increase in foreign fleets has affected local communities. Statistically, the likeliest answer is the country that dominates Sierra Leone's fishing industry: China. In 2019, China signed a fisheries agreement with Sierra Leone, which promises to build a \$55 million harbor, but some fishers say that boats owned by its citizens are among the worst offenders (<https://news.mongabay.com/2022/05/in-sierra-leone-local-fishers-and-foreign-trawlers-battle-for-their-catch/>). According to the Environment Justice Foundation shared with Mongabay, 73% of trawling licenses in the country, as of 2020, were held by boats either flying a Chinese flag or owned by a Chinese company. For example, in international trade relationships, foreign countries may disproportionately benefit from and overexploit the resources and economics of developing countries. Furthermore, as fish catch data for the industrial sector is reported by on-board observers who are paid by vessel owners rather than by the government, data accuracy is deemed questionable; therefore, a suitable remedial response might be for the government to recruit, train, and safeguard on-board observers, increasing data quality and the likelihood of making effective and appropriate evidence-based decisions.

### **8. Initiatives for sustainable fisheries development**

There is an ongoing project on the fisheries management plan of Sierra Leone, and the scope of the plan is for five years (2020-2025) with annual work plans to be implemented every year during the 5 years. It covers specifically targeted fish stocks, including the penaeid shrimps, Sciaenid, Sparids, and small pelagic (herring) in the Exclusive Economic Zone (EEZ) of Sierra Leone.

However, given that fisheries resources are multi-species in nature and are exploited by diverse fisheries using multiple gears, it is suggested that for effective management, the plan should focus on measures per fleet segment (Shrimper, Demersal, Pelagic, and Tuna). Small-scale fisheries (SSFs) in the Mediterranean constitute about 80 percent of the fishing fleet (FAO, 2021) and are not in the least "small" as they have an enormous contribution to the successful implementation of quite a few Sustainable Development Goals (SDGs) (Teh *et al.*, 2020).

### **Highlighting ongoing projects and initiatives**

The overall objective of this fisheries management plan is to create a profitable fisheries sector that contributes significantly to socio-economic development through sustainable management and utilization of fisheries resources, while also conserving the environment. In the medium term, the management plan will set levels of sustainable exploitation for targeted fisheries, and create rights and allocation mechanisms for such fisheries.

However, there is an ongoing effort to evaluate fish stocks using the Scientific Fisheries Observer program through the World Bank-funded project, GEF-AF. A comprehensive fish stock appraisal must be conducted to ascertain the current biomass (standing stock) vis-a-vis the potential yield and fishing effort per fishery.

The recent fish stock assessment conducted by the Norwegian Research Vessel, Fridt of Nansen, and the ongoing fishery survey funded by the Chinese Government will provide insight into the current status of fish stocks and inform the management of measures to effectively manage fisheries resources (FAO, 2019). However, in the absence of the required data and stock assessment results, the ministry is implementing a precautionary approach to promote the sustainability of the fishery sector.

### **Collaboration between government, NGOs, and local communities**

Simultaneously, the GMC project's NGO partner, the Sustainable Fisheries Partnership (SFP), works to engage international seafood retailers and buyers to help support the critical improvements needed for the sustainability of fisheries. The model harnesses market incentive tools and bottom-up public governance efforts to effectively drive sustainability in the middle of the fishery supply chains (<https://www.thegef.org/news/holistic-approach-sustainable-fisheries-and-blue-economy>).

To date, the project has facilitated new fisheries policy consultation forums in Costa Rica, Ecuador, and Indonesia, and has strengthened the fisheries management technical working groups in the Philippines. The GMC Project also provides direct assistance to seven fishery improvement projects (FIPs) and indirect support to two other projects. Among these nine FIPs, the project contributes to improving the sustainability of an estimated 344,313 metric tons of annual seafood landings. The SFP has also helped eight major global seafood retailers adopt or improve their sustainable seafood purchasing policies and has engaged an additional 29 international seafood supplying companies in four relevant supply chain roundtables to support fisheries improvements across the globe.

### **9. Future outlook and prospects**

The restoration of peace coincided with the publication of a new and currently operative Fisheries Policy (2003), which promised to foster responsible fishing practices and the sustainable development of the fishery in a manner that would contribute to the alleviation of poverty within Sierra Leone. A growing body of research shows that improved fisheries management can help recover overfished stocks in a wide range of ecosystems worldwide (Hilborn *et al.*, 2020)

Sierra Leone, with its expansive coastline along the Atlantic Ocean, has rich marine resources that have the potential to drive economic growth and food security. The fishery industry in Sierra Leone, which is historically significant, is poised for a transformation that can unlock its full potential.

A detailed study on fisheries and their associated organisms is highly imperative to understand the stock assessment of fishes around the world (Gopalakrishnan *et al.*, 2011; Venmathi Maran *et al.*, 2012). Fish could be associated with many organisms, including parasites and microorganisms producing important enzymes, which can significantly impact fish health and sustainability (Boxshall *et al.*, 2008; Venmathi Maran *et al.*, 2021). Studies on marine enzymes provide insights into potential applications and interactions within the marine ecosystem, further aiding in sustainable fisheries management (Barzkar *et al.*, 2024 a.b.c; Jahromi *et al.*, 2021; Barzkar *et al.*, 2021; Barzkar *et al.*, 2023).

### **Analysis of the potential for growth and sustainability**

Sierra Leone's fishery sector has been a vital component of its economy for decades. It not only provides direct employment to thousands of Sierra Leoneans but also significantly to the nation's export earnings. This sector encompasses a wide range of activities, including artisanal fishing, aquaculture, and seafood processing. Some investment potential in the fishery industry for growth and sustainability includes the following.

- Modernizing fishing practices: Sierra Leone's artisanal fishing industry can benefit from new technologies, equipment, and vessels that improve efficiency and sustainability. Investors can support the acquisition of modern fishing boats, sonar equipment, and fish-processing facilities.
- Aquaculture development: Investors can explore opportunities to set up fish farms, shrimp ponds, and hatcheries. With the appropriate infrastructure and technology, Sierra Leone has become a major aquaculture hub in the region.
- Seafood processing and value addition: Investments in seafood processing facilities can add significant value to Sierra Leone's fishery products. Processing plants equipped with state-of-the-art machinery for cleaning, filleting, and packaging can enhance the quality and competitiveness of seafood.
- Sustainable resource management: Investors can collaborate with local authorities and organizations to support sustainable fishery management practices. These include initiatives to combat illegal fishing, protect marine ecosystems, and enforce regulations.
- Infrastructure development: Investment in port facilities, cold storage, and transportation infrastructure is essential for the growth of Sierra Leone's fisheries sector. Improved infrastructure ensures that harvested seafood reaches markets under optimal conditions.

### **Consideration of emerging trends and opportunities**

Strategies for successful investments in emerging and opportunities for growth and sustainability in the fisheries sector include the following:

- Due to diligence and partnerships, investors should research local regulations, market dynamics, and potential risks. Building partnerships with local fishing communities, cooperatives, and government agencies can facilitate a smoother entry into the industry.
- Sustainable Practices embrace sustainability as a core investment principle. Supporting sustainable fishing practices safeguards the environment and ensures long-term profitability. Collaborate with organizations and initiatives focused on responsible fisheries management.
- Capacity building: Invest in human capital by providing training and education for local fishermen and workers. Empowering the workforce with the knowledge and skills required to adopt modern and sustainable practices is the key to success.
- Quality assurance: Maintaining high-quality standards in seafood processing and export is crucial. Robust quality control measures and certifications should be established to meet international standards, thereby expanding export opportunities.
- Market diversification has diversified the export market for Sierra Leonean seafood products. Explore opportunities to export to neighboring countries and tap into international markets to reduce dependency on a single market.

For investors looking for expansion prospects, Sierra Leone's fisheries industry offers a wealth of unrealized potential. By carefully utilizing industrialization, fish farming, environmentally conscious methods and facilities, and diversifying their markets, shareholders can provide significant profits and bring to the nation's growth in GDP and food security. Investors must approach the nation's fishing sector with dedication to sustainability, conscientious resource management, and cooperation with regional stakeholders. Generating growth in this industry benefits investors, coastal people's livelihoods, and the long-term



sustainability of Sierra Leone's aquatic ecosystems. The moment to invest is now because the fisheries sector has the potential to lead Sierra Leone's sustainable GDP growth.

## 10. Conclusion and remarks

### Recommendations for addressing challenges

1. To give lawmakers, donors, and all stakeholders a focus and aim for cooperative development efforts, it is necessary to disclose and thoroughly explain to them the potential contribution of an organized set of beneficial fisheries to the national GDP, revenue generation, and psychological health, in addition to other direct benefits, particularly food supply, and employment.
2. To truly grasp what is at risk, there is an obligation to improve relationships and comprehension of important topics within the government itself across pertinent departments (such as Fisheries, Finance, and Planning).
3. In Sierra Leone, a structure for the administration of fish stock expansion, particularly fishery management, is still lacking. The finalization of the framework is pending. The creation of a supportive legislative environment and the planning of efficient fisheries management programs are two particularly important concerns. Moreover, the institutions related to fisheries, particularly the MFMR, are inadequate and need significant reform and capacity-building. Because the institutions and governance framework serve as cornerstones for future fishery improvement, the government of the Republic of Sierra Leone and its donors must move swiftly to resolve these concerns.
4. If these pivotal elements are addressed decisively, it is imperative to provide future fisheries development in Sierra Leone with suitable funding, ventures, technical assistance, and capacity building.
5. Implement strict laws that safeguard the marine environment, even if they are controversial in the short term. Examples of these laws include intentional and efficient regulation of IUU fishing and the use of illicit fishing gear.
6. Create a unified union between local fishing organizations and the government to represent and oversee communities of fishermen and concerns.
7. Offering government jobs to a larger percentage of workers as watchmen on fishing boats, protecting and teaching them, and producing high-quality data may further direct more efficient, sustainable, and better use of nautical fish resources.

### Promoting Sustainable Fisheries in Sierra Leone

The review employs a scorecard approach to identify the primary advantages and disadvantages of the fisheries sector, the critical issues that require attention, and the areas of emphasis for focused solutions. Effective fisheries management is essential to achieving long-term healthy and resilient fisheries and supporting the cultural, economic, health, and social benefits that they provide (Gaines *et al.*, 2018). However, fishing activities and human well-being are embedded within broader social and economic systems that fisheries managers cannot address alone (Giron-Nava *et al.*, 2019).

The authors feel that the Government of Sierra Leone and its collaborators in development must pay immediate attention to three major areas, even though many of the difficulties have already been highlighted and explored in this study.

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### **Conflict of Interest declaration**

The authors declare that they have NO affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

### **Author Contributions**

SJK, NB, BAVM contributed to the design and implementation of the review, writing the original draft and editing; DYC, KDK, AS, RO, OB, SS helped in collecting literature and editing. All authors accepted the final draft

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