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WORLD MARITIME UNIVERSITY

Malmö, Sweden

**SOCIOECONOMIC IMPACTS OF ILLEGAL
UNREPORTED AND UNREGULATED (IUU)
FISHING ON SIERRA LEONE**

By

MICHAEL TAMBA FILLIE

Sierra Leone

A dissertation submitted to the World Maritime University in partial
fulfilment of the requirement for the award of the degree of

MASTER OF SCIENCE

In

MARITIME AFFAIRS

(SHIPPING MANAGEMENT AND LOGISTICS)

2019

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Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature): **Michael Tamba Fillie**

(Date): 24 Sep. 19

Supervised by: Prof. Anish Hebbar

Supervisor's affiliation

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Abstract

Title of Dissertation: **Socioeconomic Impacts of Illegal Unreported and Unregulated Fishing on Sierra Leone**

Degree: **Master of Science**

Illegal, Unreported and Unregulated (IUU) fishing has become a global concern as the fish stock of most EEZs of coastal states are either fully exploited or overexploited. The ocean's fish stock is fast depleting, and this will have economic consequences. The Sierra Leone fishing industry used to provide fortune for its coastal communities. The decline in catch of the country's fish stock is mostly attributed to IUU fishing activities such as poaching, use of undersized fishing net, fishing in prohibited areas, and many other prohibited fishing activities. Quantifying the nature and extent of IUU fishing is important in estimating potential losses suffered by coastal States, addressing uncertainties in stock assessments and planning effective monitoring, control and surveillance (MCS) investments. To that end, this research estimated the probable minimum and maximum values of illegal fish-catch in the EEZ of Sierra Leone from 2009 to 2018 by industrial fishing vessels. The result showed that the country is losing millions of dollars to IUU fishing. This research also showed that IUU fishing severely impacts the artisanal fishers. Fish stock is being depleted, and there are not enough alternative employments to absorb those fishers pulling out of fishing.

***Keywords:* Illegal Unreported and Unregulated fishing, economic impact, social impact, illegal fishing, Sierra Leone fishing industry, exploitation, Artisanal fishing, industrial fishing, overfishing.**

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List of Abbreviation

AIS	Automatic Identification System
ATLAFCO	Atlantic Regional Convention for Fisheries Cooperation
CCE	Canary Current Large Marine Ecosystem
CCAMLR	Commission for the Conservation of Atlantic Marine Life Resources
COFI	Committee of Fisheries
DWF	Distant Water Fleet
EEZ	Exclusive Economic Zone
FAO	United Nations Food and Agricultural Organisation
GCLME	Guinea Current Large Marine Ecosystem
GDP	Gross Domestic Product
GRT	Gross Tonnage
IEZ	Inshore Exclusive Zone
IPOA-IUU	International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
IUU	Illegal Unreported and Unregulated
JMC	Joint Maritime Committee
JOC	Joint Operations Centre
MCS	Monitoring Control and Surveillance
MFMR	Ministry of Fisheries and Marine Resources
MRAG	Marine Resource Assessment Group
OECD-DAC	Organisation for Economic Cooperation and Development- Development Assistance Committee
PSMA	Port States Measures Agreement
RFMOs	Regional Fisheries Management Organisations
SLAFU	Sierra Leone Artisanal Fishermen Union
SLIEPA	Sierra Leone Investment and Export Promotion Agency
SLMA	Sierra Leone Maritime Administration
SRFC	Sub Regional Fisheries Commission
UBC	University of British Columbia

UNCLOS United Nations Convention for Law of the Sea

VMS Vessel Monitoring System

1 GENERAL OVERVIEW OF THE SUBJECT

Illegal Unreported and Unregulated fishing (IUU) is a widespread practice that has attracted attention globally due to its undermining nature to both national and international fisheries management efforts (Stokke, 2009). Illegal fishing has existed from ages, but in recent decades there has been a sharp rise in the practice due to several factors including significant technological progress in motorization, refrigeration, improved gear and new forms of stocks detection (Coelho et al, 2008). IUU fishing is undertaken by all kinds of vessels, and it is mostly driven by the economic benefits enjoyed by the doers (Schmidt, 2005). To that end, Schmidt (2005) argued that implementing measures that will reduce the net benefits of IUU fishing on one hand, but increase cost of engaging in the act on the other hand, will demotivate those engaged in the act.

Further, IUU fishing activities do not only pose economic threat, but also pose threat to food security. Fishery is an important source of food and livelihood for many people around the globe. About one billion people depend on fish and fisheries products for both protein and a means of livelihood (Tidwell and Allan, 2001). The high dependency of people on fish in particular the developing countries is due to the fact that it provides a cheaper source of protein, as many people cannot afford alternative protein sources due to poverty. Hence, any decline in fish supply will make these people vulnerable (Kent, 2003).

Additionally, fisheries contribute to the GDP of many countries. Blanchard et al (2012) purported that about 80 million metric tonnes of fish hits the market every year for direct consumption and other uses. This huge landing does not only provide trade for fishmongers which form significant proportion of petty traders in several nations, but also lead to further industrial processes which in turn create several jobs. Revenues in terms of taxes generated from these trades provide significant contribution to the GDP of many states with this natural resource.

Sierra Leone is one of the countries blessed with this natural resource. The FAO has indicated that Sierra Leone has abundant water resources, with huge growth potentials in fisheries. The country's fishery industry consists of artisanal, industrial and inland fisheries, and aquaculture. The industry serves as a significant source of employment, income, and the largest single source of protein for the majority of Sierra Leoneans. In 2010, the fishery sector contributed about 7 percent to the country's GDP.

Although the country has very productive coastal waters, the FAO profile on Sierra Leone indicates that the country is losing an estimated US\$ 29 million every year to illegal fishing vessels. These vessels engage in unsustainable fishing practices that will result in stock depletion, forcing artisanal fishermen further out to sea, thereby compromising their safety, livelihood and food security. This will lead to over fishing and subsequent stock decline.

At global level, there are now concerns regarding over fishing. According to Erceg 2006, several authors have indicated that there has been a steady decline in fish catch in recent decades; and several articles have pointed out IUU fishing as the main cause owing to the fact that it impairs conservation and management measures, and threatens the existence of targeted species and their ecosystem. These scholarly contributions have heightened the concerns at international level. These concerns over the period prompted Regional Fishery Management Organizations (RFMOs) to develop approaches to combat IUU even though the approaches have generally failed. These failures have created acute need to initiate new approaches such as increasing the control of coastal states (Erceg, 2006) through cooperation, collaboration and coordination over their maritime jurisdiction.

1.1 Aim

IUU fishing can lead to so many impacts including, but not limited to, economic, environmental, social, ecological health and nutritional impacts. The aim of this research however, is to evaluate the economic and social impacts of IUU fishing on Sierra Leone from 2009 to 2018. It is worth noting that quantifying the level of illegal fishing is, by its very nature, extremely difficult. However, this research will attempt to estimate the probable value of illegal catch using the number of industrial fishing vessels arrested in the last decade as proxy.

1.2 Brief Background of Sierra Leone

Sierra Leone is located on the west coast of Africa. It is bordered on the north and northeast by the Republic of Guinea, on the east and southeast by the Republic of Liberia, and on the west and southwest by the Atlantic Ocean. The country has an advantageous geography and abundant natural resources. It has access to one of the largest and deepest natural harbours in the world. Further, the country possesses significant renewable natural resource in the form of land, forests, and fisheries. About 75 percent of the country's total land area (which is about 71,740 km²) is arable. Additionally, the country has abundant rainfall which can be between 3,000–5,000 mm per year along the coast, and decreases progressively inland to 2,000–2,500 mm at the eastern border. There is an average of 2,187 hours of sunlight per year or an average of 6 hours of sunlight per day (Sierra Leone Investment and Export Promotion Agency (SLIEPA), 2014).

Also, the country has 12 river basins, including Kolente, Kaba, Rokel, Pampana, Sewa, Moa, and Mano, which empty into the Atlantic Ocean thus, bringing food and nutrient that support primary production. Internal renewable water resources are estimated at 160 km³ per year, with surface water accounting for 150 km³ per year. Rainfall, soil, sunlight, and river basins endow the country with land of high natural fertility considered suitable for a wide variety of food and cash crops and high crop yields (World Bank, 2018). With a continental shelf area of 30,000 Km², an

Exclusive Economic Zone area of 155,700 Km² and a coastline of about 506 km (SLIEPA, 2014), Sierra Leone is abundantly rich in fish resources and is endowed with diverse species of finfish, shellfish, and wetland resources.

Additionally, the country is endowed with rich natural resources including mineral ores forest and marine resources. This is not however translated into the economic development of the country. The country has a small economy with a GDP of about 4.8 billion USD and a high level of poverty, and it is ranked the 183rd country on the Human Development Index out of 187 countries (UNDP, 2014). Between 1991 and 2002, the country was overtaken by a devastating civil war which worsened its economic condition. Nonetheless, the end of the war (the war ended in 2002) was followed by a rapid infrastructural and economic development, but this soon came to a dramatic halt between 2014 and 2015 by the Ebola Virus Disease as the GDP growth dropped from 11% to 4% (Neiland, et al, 2016). Figure 1 below depicts the map of Sierra Leone.



Figure 1: Map showing Sierra Leone and its neighbouring countries
Source: EU Country Environmental Profile for Sierra Leone, (2006)

1.3 Brief Introduction of Socioeconomic Impacts of IUU Fishing

Distant Water Fleet (DWF) from Asia and developed nations are the major contributors to the rise in IUU fishing in Africa. The Africa Union's Inter-African Bureau for Animal Resources (AU-IBAR, 2016) indicated that 2.8 million tonnes of IUU fish is caught in Africa's EEZ by the Chinese DWF alone. Further, the encroachment of IUU fishing vessels in the Inshore Exclusive Zone (IEZ) leads to unhealthy competition with artisanal fishermen for fishing grounds which result to overfishing, and in some cases heighten confrontation as the IUU fishing vessels destroy fishing gears and boats of the artisanal fishermen.

While Illegal fishing contributes to overfishing, Agnew et al (2014) point out that the loss of revenues in terms of taxes, licenses fees, export revenues, port revenues, stock reduction, unemployment, food insecurity, and expenditures for MCS operations are some economic and social impacts of IUU fishing at both national and community/household levels. Further, Agnew et al (2014) indicates that majority of the inhabitants of coastal communities depend on fishing either directly or indirectly for income and livelihood hence, the social impact is linked with the economic impact. Therefore, depletion in fish stock would lead to a lot of social problems including, but not limited to, unemployment fishermen, unemployment of women in fish processing and fish trading, and availability of fish in the local market at affordable prices (that is food insecurity). This in turn will have an indirect negative effect on other traders to whom the fishing communities serve as market for their products.

According to the Sierra Leone Investment and Export Promotion Agency (SLIEPA) 2014, the Sierra Leone artisanal fisheries sector alone provides about 160,000 direct employments for the country's fishing communities with about 8000 boats. The sector's annual production is about 120,000 metric tons, of which over 70 percent is

consumed locally. The country has six districts with over 641 landing sites where artisanal fishing activities are concentrated. Further, the annual export earnings from the artisanal sector is estimated at over 9.3 million USD (SLIEPA, 2014). Additionally, the UNDP (2014) points out that the fisheries industry as a whole contributes significantly the country's GDP. Hence, any depletion of the country's fisheries resources will lead to severe socioeconomic consequences as mentioned above. A detailed analysis of the social and economic impacts of illegal fishing on Sierra Leone is given in results and analysis (that is chapter 4).

1.4 Overview of IUU Fishing

The concept of 'IUU fishing' first emerged during the 1990s in response to perceived gaps in the existing international legal and policy framework that governed the exploitation of living marine resources (Tsamenyi et al, 2015). While concerns to address these inadequacies remained paramount at regional level, efforts to fill the gaps in the 1982 United Nations Convention on the Law of the Sea (UNCLOS) were championed by the relevant international organizations in high seas management of straddling and highly migratory stocks to identify and reduce the impact of fishing by parties not subject to or complying with their management measures.

To that end, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was the first organization to act. The CCAMLR developed a suite of conservation and management measures to address the escalating uncontrolled fishing activities by several non-member and member states in the Southern Ocean. In another development, Australia submitted a paper at the 23rd Session of the FAO Committee of Fisheries (COFI) urging FAO to develop an international plan of action to combat IUU fishing. Following these developments, the term "IUU fishing" was then formally adopted by FAO and became focal point of the Organization's international fisheries policy at the 23rd Session of COFI in February 1999 (Tsamenyi et al 2015).

As noted by Tsamenyi et al (2015), rapid developments after the 23rd Session of COFI between 1999 and 2000 cemented the IUU fishing concept which eventually led to its adoption by the FAO Council of the International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU) at its 120th Session in June 2001. The IPOA-IUU text comprises the most commonly accepted working ‘definition’ of IUU (FAO, 2001), and has been adopted in a range of instruments including the FAO Port State Measures Agreement (PSMA).

The IPOA-IUU provides a descriptive definition for a number of activities under each of the IUU components as follow:

Illegal fishing refers to fishing activities:

conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations; or

conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organization but operate in contravention of the conservation and management measures adopted by that organization and by which the States are bound, or relevant provisions of the applicable international law; or

in violation of national laws or international obligations, including those undertaken by cooperating States to a relevant regional fisheries management organization.

Unreported fishing refers to fishing activities:

which have not been reported, or have been misreported, to the relevant national authority, in contravention of national laws and regulations; or

undertaken in the area of competence of a relevant regional fisheries management organization which have not been reported or have been misreported, in contravention of the reporting procedures of that organization.

Unregulated fishing refers to fishing activities:

in the area of application of a relevant regional fisheries management organization that are conducted by vessels without nationality, or by those flying the flag of a State not party to that organization, or by a fishing entity, in a manner that is not consistent with or contravenes the conservation and management measures of that organization; or

in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law.

Tsamenyi et al (2015) further indicated that the IPOA-IUU definition is the working definition for the FAO, and a number of national and international instruments directed at combating IUU fishing considerably evolved since its adoption.

1.5 Problem Statement

The fisheries sector provides employment and livelihood for about half a million people, and contributes significantly to the Sierra Leone economy. The country's annual fish export, license fees, and the domestic revenue of the sector contribute greatly to the total revenue. In 2013, the fisheries sector contributed about 10.2% to the country's GDP (UNDP, 2014)

However, in the last two decades IUU fishing activities, mainly by the Chinese distant water fleet, have increased in West Africa. Countries greatly affected include Senegal, Guinea, Sierra Leone and Liberia (Dodo, 2009). This has challenged the prospect of the fisheries resources of these countries but Sierra Leone.

The lack of effective fisheries management system and limited capability to patrol its own EEZ has made Sierra Leone highly vulnerable to illegal fishing by foreign fleet. This poses threat to the very existence of the country's fisheries resources as it leads to both economic and biological overexploitation (Neiland, 2016). For the first time

in the history of Sierra Leone, a closed season was observed in April 2019 (Sierra Leone Ministry of Fisheries and Marine Resources, 2019). During this one month period, all industrial fishing vessels were prevented from undertaking fishing activities partly as a fishery management strategy and partly because the fisheries resource of the country is thought to be exploited at a biologically unsustainable manner. This unsustainable exploitation is mainly attributed to IUU fishing activities.

However, many Sierra Leoneans do not know the extent of illegal fishing in the country, since most reports about illegal fishing in the EEZ only discussed the issue as a general problem, but do not economically quantify the magnitude of the problem. As a result, the actual impacts of illegal fishing on the nation's economy is unknown.

So, this research will estimate the probable losses of the country to illegal fishing, and the results can be used to make informed decision on fisheries management systems and MCS operations by policy makers.

1.6 Assumptions

For the purpose of this research, the following assumptions are made:

- a. All catch made by unlicensed industrial vessels are considered illegal.
- b. All catch made by licensed industrial fishing vessels in violation of the Sierra Leone Fisheries and Aquaculture Act 2017, are considered to be illegal.

1.7 Purpose of the Study

Studies have revealed that the impacts of IUU fishing are often pronounced in developing coastal States that heavily rely on fishing for income and livelihood (MRAG, 2005). To that end, it is important to quantify the nature and extent of IUU fishing in order to determine potential losses suffered by coastal states, address uncertainties in stock assessment, and plan effective monitoring, control and surveillance (MCS) operations.

Lack of knowledge on the level of IUU fishing might negatively impacts habitats, by-catch, and leads to incidental mortality of endangered and threatened species, overfishing.

So, the purpose of this study is to determine the probable economic and social impacts of IUU fishing carried out by unlicensed foreign industrial fishing vessels in the EEZ of Sierra Leone.

1.8 Research Questions

The following are the research questions:

- I. How much revenue is Sierra Leone losing in the fishing industry due to illegal unreported and unregulated (IUU) fishing?
- II. What is the impact of illegal fishing on the artisanal fishing sector?

1.9 Delimitations

IUU fishing (according to IPOA-IUU definition) constitutes three elements namely; illegal, unreported and unregulated. This study will only look at the illegal aspect of IUU fishing. That is, the researcher will attempt to estimate the catch of the illegal industrial fishing vessels in the EEZ of Sierra Leone from 2009 to 2018. The study will not cover the illegal catch of artisanal fishing vessels.

For the purpose of this research, illegal fishing constitutes poaching, unlicensed industrial fishing vessels and fishing conducted by licensed vessels but in violation to national law. According to the Marine Resource and Assessment Group (MRAG), fishing in contravention to national law includes, but not limited to, using illegal fishing gear, catching fish over the allocated quota, fishing in closed areas and/or seasons, exceeding by-catch limits, partial or non-reporting of data, or submission of erroneous data, fishing endangered species, failure to renew license and many others (MRAG, 2005).

1.10 Disposition

This research will be divided into five chapters. Chapter 1 will look at the general overview of the subject. Here IUU fishing will be discussed in general terms, and some interventions by international organizations to deter the problem are looked. Chapter 2 will review the works of other studies in the area in order to evaluate the extent of the problem. It will further look at the efforts of Regional Fisheries Management Organizations in dealing with IUU fishing, the general set up of the Sierra Leone fishing industry, and the contribution of the fisheries sector to the country`s GDP. Chapter 3 talks about various methods used in the estimation of illegal catch, and the method used in this study. Chapter 4 talks about data and analysis, whilst chapter 5 concludes the studies and proffer recommendations.

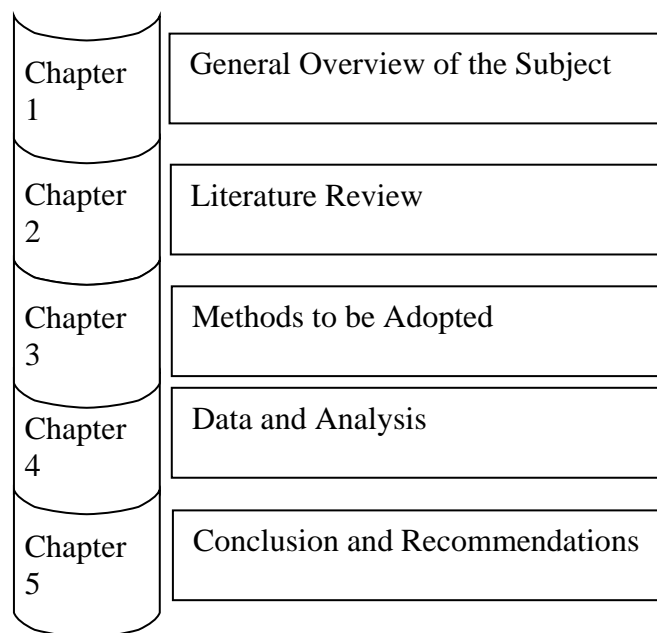


Figure 2: Chapter Overview

1.11 Definitions of Some Key Terms

a. Impact:

The Organisation for Economic Co-operation and Development – Development Assistance Committee (OECD-DAC) defined impact as “Positive and negative,

primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended.”

Also, according to the United Nations Development Group (UNDG) Impact implies “changes in people’s lives. This might include changes in knowledge, skill, behaviour, health or living conditions for children, adults, families or communities. Such changes are positive or negative long term effects on identifiable population groups produced by a development intervention, directly or indirectly, intended or unintended. These effects can be economic, socio-cultural, institutional, environmental, technological or of other types.”

So, deducing from all these definitions, an impact can be defined as an outcome which is positive or negative, intended or unintended produced by an intervention or action on a situation.

b. Social Impacts:

The Centre for Social Impact (CSI) defined social impact “as the net effect of an activity on a community and the well-being of individuals and families.”

c. Economic Impact:

Economic impact is defined by the Business Dictionary, as “a macroeconomic effect on commerce, employment, on incomes produced by a decision, event or policy.”

2 LITERATURE REVIEW

Humans have exploited fish and fisheries resources for food and employment for thousands of years. This progressive and never ending exploitation of fish has subjected the oceans to unprecedented fishing intensity and a global commoditization of fishery products (Pitcher & Cheung, 2013) as humans increase their search for fish in terms of area and depth for profit. Fishing does not only provide livelihood but it is also a source of protein. Fish serves as an excellent supplement to cereal-based diets which are deficient in nutrition, and provide food for more than 1.5 billion people, particularly in low-income and food-deficit countries (FAO, 2010).

In West Africa, small-scale fishing serves as a significant means of livelihood and food security. Greater proportion of artisanal fishers in West Africa is small-scale fishers who heavily depend on fishing to make ends meet. The catch of small-scale fishers has increased from 599,000 tonnes per year in the 1950s to 2.4 million tons per year in the 2000s. Accordingly, active small-scale fishers in West Africa also increased from 953,000 in the 1950s to over 1.7 million in 2010, injecting about 14.7 billion USD in the GDP of the region (Belhabib et al, 2015).

However, the emergence of IUU fishing has presented a major challenge to the potentials of the world fishing industry, and billions of tonnes of fish are lost every year to IUU fishing. Illegal fishing is not only a threat to food security, but also has economic, social and environmental consequences. Further, illegal fishing undermines fisheries management efforts, and it is the main cause for fish stock depletion (Eggert, 1998).

Eggert 1998 further indicated that the world fisheries are exploited in a manner that is destructive and unsustainable, thus resulting in the collapse of fish stock. The

depletion of the world's fish negatively impact not only the socio-economic lives of those whose livelihood depend on fishing, but also the economic stability of many nations. And therefore, it is imperative to determine the extent of illegal fishing.

Over the period, efforts to quantify IUU catch have been made by several scholars (for example: MRAG, 2005; MRAG and UBC, 2008; Agnew, 2009). According to the Marine Resources Assessment Group (MRAG) 2005, the worldwide value of IUU catch is between 4.2 billion USD and 9.5 billion USD per year. Also, a more recent work by MRAG and the University of British Columbia (UBC) estimates the global value of illegal catch to be between 10 billion USD and 23 billion USD (MRAG and UBC, 2008). And Agnew 2009 puts the global loss of illegal fishing to be valued between 10 billion USD and 23.5 billion USD representing 11 and 26 million tonnes respectively in terms of volume.

According to Agnew 2009, the increase in world's population, the high demand for fish, and the lack of good fisheries management systems are the recipe for the rise in illegal fishing. While Agnew 2009 conducted a global estimate of illegal catch, MRAG 2005 conducted its estimate of illegal catch at country level for 10 countries in Africa and Oceania. The results indicate that developing countries are losing many millions of dollars to illegal fishing.

Additionally, the West Africa Progress Panel report in 2014 indicates that West Africa is at the centre of devastating consequences illegal fishing. Overexploitation of the region's fisheries resources has produced devastating socioeconomic consequences for the coastal states of the regions. The decline in the fisheries resources of the West Africa waters ruined the livelihood of the artisanal fishers, and destroys every opportunity for regional development. Further, West Africa fisheries have been fished beyond their maximum sustainable yield (MSY). More than 50% of the coast stretching from Senegal to Nigeria has now been overfished and it is

estimated that IUU accounts for about one-third to half of the region's total catch (FOA, 2011; Africa Progress Panel, 2014).

Accordingly, West Africa is losing more than 1.3 billion USD annually to IUU fishing (Africa Progress Panel, 2014). More specifically, Senegal, Guinea and Sierra Leone are losing about 300 million USD, 110 million USD and 29 million USD respectively (USAID, 2013; MRAG, 2005:6). Agnew et al 2009 further indicated that 40% of the reported catch in West Africa is illegally caught, and in some countries such as Guinea, the IUU catch surpasses the legal catch.

Besides the economic consequences, Bene et al 2007 indicated that illegal fishing has devastating social impacts on the region. The livelihood of millions of artisanal fishers has collapsed leading to revenue loss as national and intra-regional trades between consumers and artisanal fishers are destroyed.

2.1 The Sierra Leone Fishing Industry

Sierra Leone is blessed with rich fisheries resources with the potential to significantly contribute to food security, income and employment. While conforming to the United Nations Convention on the Law of the Sea (UNCLOS), the country claimed a 200 mile EEZ (FAO 2008) in the early 1980s. With a coastline of about 570 Km, the total area of the EEZ extends to cover an area of 155,700 km². This EEZ lies in the Guinea Current Large Marine Ecosystem (GCLME) which runs from Senegal in the North to Angola in the south. Both GCLME and the Canary Current Ecosystem (CCE) provide nutrients for the country's pelagic and demersal fish stock (SLIEPA, 2014) thus supporting varieties of fishes including snapper, grouper, catfish, barracuda, tuna, cuttlefish, squid, lobsters, shrimps, herring, sea bream which are exported.

The country's fishing industry is divided into three sectors: (1) the industrial fishery (highly mechanized and capitalized fishing), the artisanal fishery (low technology small-scale fishing), and (3) the aquaculture and inland fisheries which is not fully

developed. The Sierra Leone Ministry of Fisheries and Marine Resources (MFMR) is the sector responsible for administering the country's fisheries related matters (EU-CEP, 2006). The EU Country Environmental Profile (EU-CEP, 2006) for Sierra Leone further indicated that in 1987/88, fisheries contributed about 11 percent to the country's GDP. However, this promising potential of the industry was however destroyed during the 11-year war (from 1991 to 2002). Before the war (1985 to 1990), the peak catch of the country was about 230,000 tonnes per year. This dropped to about 60,000 tonnes/year during the war, but increased to about 83,000 tonnes in 2003 (that is immediately after the war) (EU-CEP, 2006).

According to the MFMR, the country's annual fish production is about 150,000 tonnes. The industrial fishing sector accounts for about 24,000 tonnes of this catch which is valued at 25 million USD per year, whilst the artisanal sector accounts for about 120,000 tons valued at 100 million USD per year (World Bank, 2017).

The fisheries sector provides employment and livelihood for about 500,000 people, and contributes significantly to the country's economy. The country's annual fish export is valued at 2.5 million USD, annual license fees amount to 2.5 million USD, and the domestic revenue collected from the sector in 2014 amounts to 34 million USD which representing 1% of the total revenue. In 2008 the contribution of the fishing was 8.9% of the country's GDP, and by 2013 the sector's contribution to the GDP increased to about 10.2% (UNDP, 2014) as shown in Table 1 below.

While there is a great potential in the country's fisheries resources, the Sierra Leone MFMR on their web page cited an EU report which indicates that Sierra Leone has been unable to realize much of its fish value due to extensive illegal fishing activities in the country's EEZ (MFMR, 2019). Most of the management functions, logistics and marketing are carried out offshore by foreign partners without providing records of such activities for the attention of the relevant authorities.

Table 1: Sierra Leone GDP percentage comparison

Area	% GDP	
	2008	2013
1 Agriculture, hunting, forestry and fishing	56.3	52.7
1.1 Fishing	8.9	10.2
2 Mining	3.7	11.6
2.1 Oil	n.a	n.a
3 Manufacturing	2.6	2.1
4 Electricity, gas and water	0.2	0.2
5 Construction	1.7	1.3
6 Wholesale and retail trade, hotels and restaurant	9.2	9.1
6.1 Hotels and restaurants	0.4	0.4
7 Transport, storage and construction	6.7	4.6
8 Finance, real estate and business services	7.9	6.6
9 Public administration, education, health and social work	3.6	4.9
10 Other services	8	6.9
Total	100	100

Source: Neiland et al (2016)

2.1.1 The Ministry of Fisheries and Marine Resources (MFMR)

The Sierra Leone MFMR is the principal institution responsible for the administration of all fishing activities in the waters of Sierra Leone. Its mandate is to provide quality and affordable fish and fishery products for the country and to contribute to the GDP of the state. The mission of the MFMR is to plan, develop, rationally manage, and conserve all living aquatic resources for the benefit of the country. And its vision is to promote responsible and sustainable fishing practices through good governance while contributing to poverty reduction and wealth creation in Sierra Leone (MFMR, 2009).

The MFMR has two main divisions namely; the administrative and the technical divisions. The administrative division is headed by the Permanent Secretary, whilst

the technical division is headed by the Director of Fisheries. These two heads report to Deputy Minister, whilst the Deputy Minister reports to the Minister as shown in Figure 3 below.

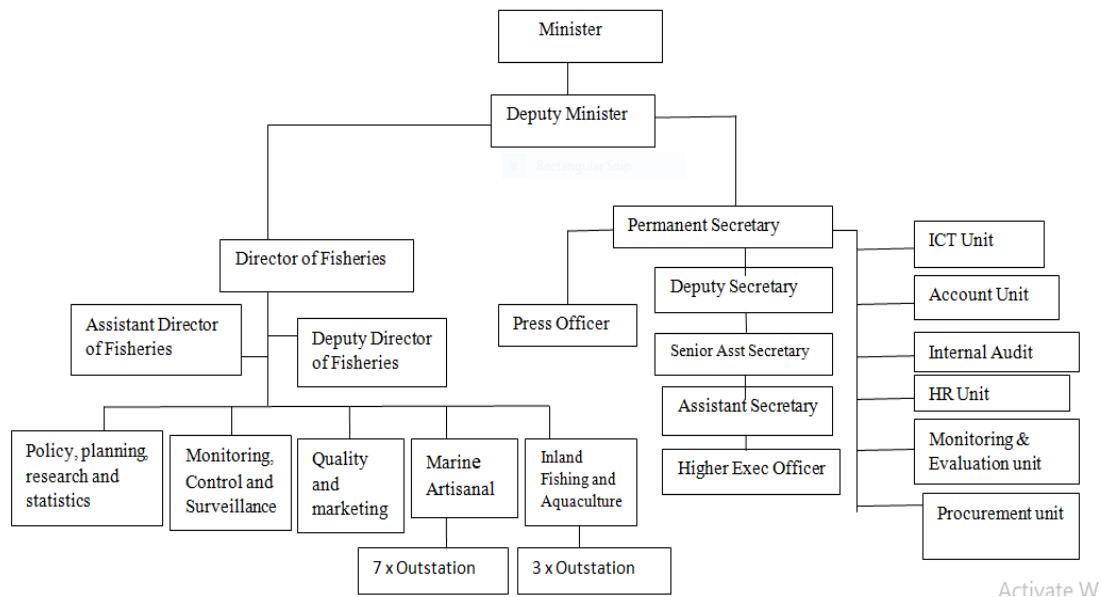


Figure 3: Organisational Chart of the Sierra Leone Ministry of Fisheries and Marine Resources.

Source: Ministry of Fisheries and Marine Resources- Sierra Leone, 2019.

The MFMR was a department under the Ministry of Natural Resources and the Ministry of Agriculture, but in 1994 it was given a full ministerial portfolio due its contribution to national economy. In the same year, fishery observer programme (wherein fishery observers are put on board industrial fishing vessels) was introduced in order to prevent illegal fishing activities by licensed vessels, and maintain a daily catch report.

In 2009, the MFMR signed memoranda of understanding with key maritime institutions for the establishment of the Joint Maritime Committee (JMC). The core responsibility of the JMC is to combat illicit maritime activities within Sierra Leone

EEZ through monitoring. To achieve this, the United States Government provided the JMC with Automatic Information System (AIS) and radar systems in 2010, which are now used in monitoring fishing vessel activities. Also, the MFMR introduced the installation of Vessel Monitoring System (VMS) transponders on all licensed fishing vessels below 250 GRT in 2011. Fishing vessels with gross tonnage (GRT) above 250tonnes should display their AIS.

2.1.2 The Industrial Fishing

The Sierra Leone industrial fishing sector is mainly export-oriented, and its fleet ownership is almost wholly foreign based. Currently, the fleet of the industrial fishing sector consists of more than 120 vessels. The sector mainly exploits demersal and shrimps. And Pelagic stock is incidentally caught as by-catches. Trawlers, shrimpers, purse seiners and carriers (also known as mother vessels) constitute the industrial vessel fleet. Foreign fishing fleet has been progressively increasing since 1978. Some companies register their vessels locally, whilst others have joint venture agreements with owners of foreign-registered and/or foreign-based vessels. Foreign vessels are charged license fees per gross tonnage (GRT) depending on whether they fish for finfish or shellfish. The country benefits from the industrial fishing sector through the license fees and royalties, and through the employment and incomes created for national employees (FAO Fish STAT Sierra Leone, 2008; Ministry of Fisheries and Marine Resources; Ssentongo et al, 1986).

In 2006, an EU sponsored studies titled Country Environmental Profile (CEP) indicates that the Sierra Leone fisheries sector contributes significantly to the GDP of the country. The studies further state that the industrial fishing sector contributed about 11 percent to the country`s GDP in 1987/88. Additionally, the FAO Fish STAT 2008, indicates that the sector contributed about 9.4 percent to the GDP of the country in 2006, and also pointing out that the fish production in 2003 for direct human consumption was about 97,000 tonnes. It is also estimated that the sector`s gross value fisheries output in 2005 is about 34 million USD, and a total of 3,500

persons were employed by the sector in the same year (FAO Fish STAT Sierra Leone, 2008).

2.1.3 The Artisanal Fishing Sector

The artisanal fishing sector is represented by two unions namely; the Sierra Leone Artisanal Fishermen Union (SLAFU), and the Sierra Leone Amalgamated Artisanal Fishermen Union (SLAFU). These two unions act as bridge between the government and the artisanal fishermen. The sector has a capacity of more than 8000 boats, and accounts for about 80% to 89% of the country`s total catch. Some of the boats are equipped with outboard engines, and others are not (SLIEPA, 2010).

According to the Sierra Leone Investment and Export Promotion Agency (SLIEPA), 2010, the artisanal fishing sector provides 160,000 direct jobs in the country, and produces up to 120,000 tonnes of fish per year. Table 2 shows the annual production of the artisanal sector from 2001 to 2007, and Table 3 shows the employment provided by the artisanal fishing sector in 2005.

Table 2: Production of the Artisanal fishing sector from 2001 to 2007

Year	Sardinella	Ethmalosa Fimbriata	Total Artisanal Fish production all species
2001	9884	24790	39950
2002	13251	31491	55659
2003	15447	28516	65458
2004	18211	51046	106216
2005	22065	52677	116614
2006	15173	60109	120490
2007	16574	52715	111939

Source: Sierra Leone Investment and Export Promotion Agency (SLIEPA), 2010.

Table 3: Employment provided by the Artisanal Fishing Sector in 2005

Employment in 2005	
Primary Sector	Artisanal Fisheries 30,000 full-time
	Industrial Fisheries 1,000 full-time
Secondary Sector	Artisanal Fisheries 200,000 part-time
	Industrial Fisheries 2,500 part-time
Gross value of fisheries output	33,628,397 USD Industrial
	74,289,236 USD Artisanal
Total	107,917,633 USD

Source: FAO- fisheries country profile

Annual export earnings are estimated at 1.9 million USD for finfish, 7.4 million USD for shrimps, and 7.1 million USD for other shellfish. The major fishing activities are concentrated in the following coastal districts: Western Area, Port Loko, Kambia, Moyamba, Bonth, and Pujehun districts, and diverse fishing methods are used for fish exploitation.

2.2 Monitoring Control and Surveillance Operations

The Sierra Leone Navy and the Sierra Leone MFMR are the sectors responsible for MCS operations, and they mostly conduct joint fisheries patrols. The Navy has five Forward Operational Bases (called FOBs) and one main operational base all along the coastline of Sierra Leone. These bases conduct regular MCS operations in order to support the goal of MFMR in deterring illegal fishing activities. Each of these bases conducts at least one patrol per week using inshore patrol crafts which can only go up to 15 to 20 nautical miles offshore, and can only take a maximum of five persons. According to the Sierra Leone Naval Commander, the target patrol for these bases is 50 patrols per month.

The MFMR on the other hand also conduct surveillance patrols. The MFMR has a 15 meters long patrol vessel which can go up to 70 nautical miles offshore. The vessel has accommodation for about 10 persons with endurance of about five days per patrol trip. This vessel is under the command of the MFMR but it is operated by officers and men of the Sierra Leone Navy.

The monitoring aspect of fisheries is handled by the Joint Maritime Committee (JMC). The JMC is run by persons from the MFMR, the Navy, and the SLMA. It has a steering group which comprises heads of these various institutions. The Joint Operations Centre (JOC) of the JMC provides the platform for monitoring. It is equipped with 24/7 internet service systems, AIS and VMS, and monitoring screens. In the event of suspicion, the JOC contacts the Navy to do a spot check where possible.

2.3 IUU fishing in Sierra Leone

The FAO 2006 indicates that all fishing grounds in West Africa are either fully exploited or overexploited mainly due to illegal fishing. This depletion adversely impacts employment opportunities and standard of living (Belhabib et al, 2017) of artisanal fishing households.

Further, Belhabib et al (2017) purported that IUU fishing has damaging economic consequences, and it is a major problem in the EEZ of Sierra Leone. It is estimated that the illegal catch of the country's fish stock is between 103,000 to 127,000 tonnes per year. Aerial surveys conducted in 2000 and 2001 revealed that 30–51% of active fishing vessels were found to be operating illegally. Other reports indicate that illegal fishing accounts for more than 26% of the total fish catch in Sierra Leone (Belhabib et al, 2017). The main illegal fishing activities conducted by industrial fishing vessels include; fishing without license, fishing with illegal nets, fishing in prohibited areas especially in the inshore exclusive zone (IEZ), and transshipment at sea without permit, to name but a few.

MRAG (2005) puts the minimum value of illegal fish catch in the EEZ of Sierra Leone to be around 29 million USD annually. This is in phase with a report by Stop Illegal Fishing (July 2018), which indicates that Sierra Leone is losing an estimated 50 million USD annually to illegal, unreported and unregulated fishing. In 2018 alone, over ten industrial fishing vessels were arrested for various fisheries violations

(Sierra Leone Navy achieve n.d). Further, the Sierra Leone Marine Police indicated that while industrial vessels carry out fishing activities in areas designated for only artisanal fishing, reports regarding industrial fishing vessels destroying fishing gears of artisanal fishers have increased over the period. This, according to Sierra Leone's newly-elected President Julius Maada Bio, "is one of the critical challenges in the fisheries sector coupled with limited accessibility to the international market". In his address during the 5th Parliament of Sierra Leone State Opening, President Bio said one of the key objectives of his 'New Direction' administration is to create a profitable fisheries industry that will considerably contribute to socio-economic development through sustainable management and utilization of the country's marine resources as well as conserving the environment (Stop Illegal Fishing, July 2018).

2.4 Regional Fishery Management Organizations/agreements

In a bid to counter IUU fishing, and provide a good fisheries management system, Sierra Leone has ratified a number of Regional Fisheries Management Agreements including the Atlantic Regional Convention for Fisheries Cooperation (ATLAFCO), Sub Regional Fisheries Commission (SRFC), and the West Africa Economic and Monetary Union (WAEMU).

ATLAFCO has 22 member states from Morocco to Namibia, and sets out the areas and modalities of regional fisheries cooperation between member states. Its main objective is the effective and active cooperation between member states for preserving fisheries resources and for sustainable development of the region's fisheries (ATLAFCO website n.d).

The Sub-Regional Fisheries Commission (SRFC) is an inter-governmental fisheries cooperation organization. It has 7 member States: Cabo Verde, The Gambia, Guinea, Guinea-Bissau, Mauritania, Senegal and Sierra Leone. The mandate of the SRFC is to enforce mechanisms for sustainable governance of fisheries resources. Its objective is in line with strengthening the regional cooperation to enhance the

sustainable management of fisheries resources in maritime waters under the jurisdiction of member States.

The SRFC has developed a number of legal instruments governing the conditions of access and control of fishing activities including:

1. Convention on the Determination of the Minimal Conditions for Access and Exploitation of Marine Resources within the maritime areas under the jurisdiction of the SRFC's Member States (MAC Convention called revised, adopted on 8 June 2012 in Dakar, Senegal), effective since the 16 September 2012:

This Convention determines the Minimal Conditions for Access and Exploitation of Marine Resources within the Maritime Areas under the Jurisdiction of the Member States of the SRFC.

2. **Declarations of "Nouakchott 20 September 2001" and "Dakar 28 March 2014" on illegal, unregulated and unreported fishing:**

These declarations are strong political commitment to the international community by the Member States of the SRFC to fight IUU fishing and sustainably preserve fisheries resources of the sub-region.

3. **Convention on sub-regional cooperation in the exercise of maritime hot pursuit and its Protocol regarding the practical modalities for the coordination of surveillance activities in the Member States of the SRFC, both adopted on 1st September 1993 in Conakry, Guinea:**

This Convention and its Protocol provides terms and modalities for strengthening cooperation between MCS units of Member States and defines the general principles governing the right of hot pursuit exercised toward any vessel operating in the waters under the jurisdiction of a member state (SRFC website n.d).

3 METHODOLOGY

This chapter puts into perspective the conduct of this research with the view to answer the research questions. First presented in this chapter, is how the researcher addresses the topic by looking at the research approach and design. This is followed by outlining the data collection process and how the respondents are selected for interview.

3.1 Research Approach

The researcher intends to use a numerical representation to describe the economic phenomenon of IUU fishing. This research finds answer to two research questions: How much revenue is Sierra Leone losing in the fishing industry due to Illegal fishing? What is the impact of illegal fishing on the artisanal fishing sector? The first question has to do with economic impacts, while the second question is concerned with the social impacts of illegal fishing on the fishing communities. Since the research is dealing both economic and social impacts, both quantitative and qualitative research methods are employed in conducting this research.

According to Fox et al (2013) quantitative research is a numerical representation of observations, and it is used to describe and explain what those observations reflect. Since data connected with economic issues are numerical in nature, quantitative research method has been adopted to find answers to the first research question. However, since data connected with social impacts are qualitative, a qualitative research is employed to answer the second question.

3.2 Research Design

According to Global Fishing Watch, IUU may occur in several forms including; fishing by foreign vessels in another country`s EEZ without license/permit, making false report on fish catch, fishing with prohibited gears, fishing in prohibited/restricted areas, and many more. All these various forms of IUU create consequences which can be economic, social and/or environmental.

The frame work to assess the economic impact of IUU fishing on Sierra Leone will deal with the effect on revenue generation. Foreign vessels that are engaged in IUU fishing evade all due processes, thereby depriving the state of potential revenue that could be used for national development. IUU fishing practices such as fishing in restricted areas and the use of prohibited fishing gears lead to rapid depletion of fish stock, and destruction to the marine environment. This does not only destroy the economy now, but also deprive future generations of economic opportunities as the fish is depleted below economic quantity. This will lead to social problems as those whose livelihoods depend on fishing become unemployed.

So, this research will look at the fishing trend of the Sierra Leone fishing industry from 2008 to 2018. Areas of interest in this trend include; the total registered vessels per year, the yearly landing, and the yearly transshipment by industrial fishing vessels. This will give an insight of how much the fishing industry is contributing to the country`s economy. Also of interest in the ten-year fishing trend, is the number of IUU fishing vessel arrested during this period and fisheries offences for which they were arrested in order to determine the extent of illegal fishing in the country.

It is important to note that precise data on how much Sierra Leone is potentially losing to IUU fishing can only be estimated by proxy as data regarding IUU fishing is difficult to get due its illegal nature. However, this research will use the Monte Carlo Model (which is a subset of the bottom-up approach) to estimate catch taken away by foreign IUU fishing vessels.

3.2.1 Data Collection

The data used in this research is mainly collected from both primary and secondary sources. Primary data is obtained from questionnaires. Questionnaires were sent to five different institutions including the Sierra Leone MFMR, the Sierra Leone Navy, the SLMA, the JMC, the Marine Police and SLAFU. Targeted respondents are those with sufficient professional. The questionnaires are complimented by secondary sources such as reports on surveillance operations conducted by the MFMR and the Navy, and various professional articles and news articles. Most of the data used in the estimation of the illegal catch is from surveillance reports produced by MRMR and the Navy. These reports are unpublished, but they cover arrests for which fines were imposed, and paid.

3.2.2 Interviews

Various stakeholders in the Sierra Leone fishing industry were interviewed. These include; the MFMR, the SLMA, the Sierra Leone navy, the JMC and the Sierra Leone Artisanal Fishermen Union (SLAFU). One person each from these various bodies was interviewed, except for the MFMR were four people (the Director and three on-board fisheries observers) will be interviewed. Hence, a total of eight respondents will be interviewed via mobile phone.

3.2.3 Selection of Respondents

The fisheries industry of Sierra Leone is run by six main institutions. These include the Sierra Leone Ministry of Fisheries and Marine Resources (MFMR), the Navy, the Sierra Leone Maritime Administration (SLMA), The marine Police and the Joint Maritime Committee (JMC). They are the institutions from which respondents have been selected. The Ministry of Fisheries and Marine Resources is the prime institution among the six with the mandate to plan, develop, rationally manage, and conserve all living aquatic resources of Sierra Leone for the benefit of the country.

All the other institutions are support arms to the MFMR to see that this mandate/vision is achieved.

Respondents will also be selected from the Sierra Leone Association of Fishermen Union (SLAFU). The SLAFU serves as bridge between the fishermen and the Government of Sierra Leone. Fishermen direct all issues affecting their fishing business to SLAFU. This makes SLAFU stands as a prominent icon in the fishing community. Hence, it is prudent to select respondent(s) from this union. While the six institutions are all government institutions, the SLAFU does not serve the government. And therefore, their information can be used for corroboration.

3.3 Estimation of Illegal Catch

The methodologies used for the estimation of volume and value of IUU fishing are mostly tailored to the type of IUU fishing activity, and are categorized into two main approaches: top-down approach and the bottom-up approach. The top-down approach estimates illegal fish-catch by taking a certain percentage of the total legal catch for a given period to be an IUU catch. As an alternative, the top down approach may also use biologically-based stock assessment models or trade data to estimate an overall level of 'missing catch' and can identify large IUU problems (Lack and Sant, 2001).

Pauly & McLean (2003) provide an expert judgment for the estimation of unreported catch as a proportion of the total global reported catch in the range of 25-30%. Agnew et al (2008) applied a top-down approach at a moderate proportion of 19% of the declared catch to be the IUU catch in their sub-Saharan Africa study.

Agnew et al (2008) used the top-down approach for number of IUU catch estimation in volume/value terms (taking 19% of the declared catch to be the IUU catch): In 2002, the total declared world catch from marine capture fisheries was about 84 million tonnes (which was 64% of total production of 133 million tonnes including

aquaculture and inland fisheries). Applying the 19% of declared catches, the world catch of IUU would be 16 million tonnes. Also, the FAO reports that in 2002 the estimated first sale value of fisheries was about US\$78bn (of which 64% was from marine capture fisheries). Applying the estimated IUU proportion of 19% to this amount would give about US\$9.5bn for total value of IUU catch. Additionally, in 2001 the net exports from developing countries worth US\$18bn (Agnew et al, 2008). Performing the same calculation, IUU value was US\$2.2bn.

Estimating IUU catch using the top-down approach is more likely to provide overestimates than underestimate, hence the result is considered as the probable maximum IUU catch (Agnew et al, 2008). On the other hand, the bottom-up approach deals with more detailed information at a local scale to build a more accurate picture of IUU fishing activity. Estimates obtained in this way are summed up to develop an overall estimate of IUU catch. Given the very nature of IUU fishing, information is both very patchy and hard to collect. So, this approach has the tendency for some types of IUU catches to be missed. Hence, the bottom-up approaches are considered to provide probable minimum estimates for IUU catch (MRAG, 2015). According to MRAG (2015), approaches of the bottom-up applied in previous studies include:

- a. extrapolations from surveillance spotting of IUU activity (CCAMLR);
- b. Monte-Carlo interpolation from direct observer data (Pitcher et al, 2002);
- c. simulation modeling of IUU behaviour (Agnew & Kirkwood 2002, 2005);
- d. comparison of trade and landing statistics (ICCAT and IOTC method); and
- e. target species population modeling techniques (Plagányi and Butterworth (in prep) 15).

MRAG (2015) indicated that most papers on IUU fishing (including most of those presented to the FAO meeting in Sydney in 2000 and the OECD meeting in Paris in 2004) basically discuss IUU fishing in general terms. Only a few papers or reports

present quantitative estimates because data are not available for IUU fishing in a large number of countries.

3.4 Methodology used in this Research to Estimate Illegal Catch

This research simply used arrests and sighting from MCS operations from 2010 to 2018 to estimate illegal catch. As discussed earlier, the navy and the ministry fisheries conduct several MCS operation per month. So, reports from these operations contain data base of IUU fishing activities. The data in these reports are normally in two folds; sighting and arrests. Sighting covers vessels suspected of being involved in illegal activities but could not be arrested. Sighting also covers information received from local fishermen about illegal fishing activities of the industrial vessels.

So, in the case of arrests, this research took the following into account:

- a. The quantity of fish onboard the vessel at the time of arrest
- b. The type of fish
- c. The type of IUU fishing activity arrested for
- d. The flag of the vessel

The method used in this dissertation to estimate the illegal catch is the bottom up approach. As discussed earlier, the bottom up approach gives a minimum estimate of illegal catch. The reason for choosing this method is to avoid overestimation of illegal catch as is the case of the top down approach. This research is intended to show the minimum impact illegal fishing on the country`s economy. As shown above, the bottom up approach consists of several approaches. For this research, the Monte Carlo approach (which is an approach of the bottom up) is used to estimate the impact of IUU fishing on the country`s economy.

MFMR and the Navy gave details of all arrests and sightings made in their surveillance operations from 2010 to 2018. In order to account for missing catch, the catch of any vessel implicated in any form of IUU fishing is considered illegal, and the vessel is considered to be at full load. The research also assumed an ideal position that all the vessels (those implicated in IUU activities) are of uniform

sizes/capacity. So, the average capacity of all vessels arrested in the period covered by this research is used as the ideal capacity for estimating the illegal catch. The formula is simple and straight forward as shown below:

Annual Impact = catch per vessel x number of vessels implicated

Let the annual impact be represented by I_a , and catch per vessel by V_c , and the number of vessels be represented by N .

So, the annual impact would be given by;

$$I_a = V_c \times N$$

So, the total impact (I_t) is the sum of the annual impacts from 2010 to 2018

That is, $I_t = \sum_{t_1}^{t_n} I_a$

Where $t_1=2010$ and $t_n = 2018$

In addition to the loss of revenue, the cost burden on government to combat illegal fishing is also an economic impact on the nation. To that effect, the research looked at government expenditures in conducting MCS operations. Parameters considered include; the frequency and trend of surveillance patrols, equipment used in these patrols and the man power involved in these patrols plus the cost implications of maintaining them.

3.5 Estimating Social Impacts

This research used questionnaires and interviews to determine the social impacts of illegal fishing on the fishing communities in Sierra Leone. Three major fishing communities including; Yeliboya, Goderich and Tombo are used as sample size. Every fishing communities in Sierra Leone has a harbour master who is responsible for administering the activities of fishermen in terms of giving manifest to fishing boats proceeding to sea, and also keeping records of both crew and boat that proceed to sea. They form part of SLAFU. So, the harbour masters of the three mentioned fishing communities are interviewed. Five parameters namely; employment, household income, gender issues, nutrition and food security, and safety and security are measured through the interview. Each parameter is measured using a particular

indicator. Employment is measured using employment rates in fishing communities as an indicator. Similarly, the availability of fish in local markets at affordable prices is used as indicator to measure nutrition and food security. Employment of women in fishing and fishing trading is used as an indicator to measure gender issues. Safety and security of fishermen is measured by looking at the frequency of conflicts between the illegal fishing vessels and the artisanal fishermen. The parameters, indicators and the impacts are the put in a table form.

3.6 Validity and Reliability

Validity and reliability of a research are factors for determining the credibility of a research work (Bryman and Bell, 2011). One advantage of the bottom up approach is that it requires detailed information to make estimate of illegal catch. That is the reason why reports from MCS operations are used as the main data source for quantifying the illegal catch. In order words, the bottom up approach by its very nature is more reliable for estimating any IUU catch. Secondly, the targeted institutions that would participate in the interview/questionnaire survey have different responsibilities with respect to the fisheries management, and the respondents chosen from these institutions have rich and on-hand experience with regards to the issue of IUU fishing activities in the Sierra Leone EEZ. Additionally, the credibility of this paper is further strengthened by ensuring that the questionnaires are designed such that they are not ‘one size fits all’ but they are tailored to the responsibility of each of the respondent institutions.

3.7 PESTEL ANALYSIS

A PESTEL analysis is a framework or tool used to analyse and monitor the macro-environmental factors that may have an impact on an organisation’s or industry’s performance. PESTEL is an acronym that stands for Political, Economic, Social, Technological, Environmental and Legal factors.

3.7.1 Political Factor:

Sierra Leone is a politically stable country. The country is open to investment, and the government sees the fishing industry as a key sector for generating revenues. Fishing is open to both local and foreign investors, and all fishing activities are regulated by the Sierra Leone Fisheries and Aquaculture Act, 2017. This act requires industrial fishing vessels operating in the EEZ of Sierra Leone to land at least 20 percent of their, pay landing and transshipment taxes, and to employ at least 60 percent of local nationals. Fishing vessels are required to take a certificate of registration form the Sierra Leone Maritime Administration before applying for license from the MFMR.

3.7.2 Economical Factor:

Sierra Leone has a weak economy with a fluctuating growth rate. According to the World Bank, Sierra Leone's economy grew by 7.8% on average during 2003-2014 but contracted by 21% in 2015 mainly as a result of the Ebola outbreak. The growth rebounded to 6.4% in 2016 only to decelerate to 3.8% in 2017 and remaining roughly stagnant at 3.7% in 2018.

Foreign exchange rate is high in the country, and this in turn leads to high inflation in the market. In 2010, \$1 was 3,900 Leones. Currently, \$ 1 is 9,151 Leones representing 235 percent increase in exchange rate. The country has a high unemployment rate, and poverty headcount of over 50 percent. Fish provides the cheapest source of protein hence it is the main source of protein as many Sierra Leoneans cannot afford alternative sources of protein.

3.7.3 Social Factor:

Sierra Leone is diverse nation. It has over 16 tribes with varying cultures. Christianity and Islam are the major religions, and majority of the fishing communities are Muslim dominated. The fishing communities are highly populated and have high illiteracy rate. Young men form the main work force for fishing.

Fridays are normally observed as non-fishing days, and some routine jobs such as mending of battered nets are done on Fridays. Fishing is the main source of income for the fishing communities, and some fishing related activities such as boat building and boat repair provide a means of livelihood for many. Polygamous marriage is common, and the women are mainly involved in fish processing activities such as smoking and packaging.

3.7.4 Technological Factor:

The country's ministry of fisheries has VMS transponders which all industrial fishing vessels are required to have onboard. The Joint Operation Centre of the JMC has a 24hour monitoring system which receives signal from the VMS onboard the vessels. Once the VMS is on, the position of the vessel at any one point can be tracked. The JOC also has AIS for tracking position of vessels operating within the EEZ of the country. The country has no dry-docking facility. However, there is slipway used repairing ferries. The Sierra Fishing Company is also constructing a small dry for the use of their fishing vessels.

3.7.5 Environmental Factor:

Sierra Leone has an EEZ of about 155,700 Km² and the area of its continental shelf is about 30,000 Km². The country's Inshore Exclusive Zone (IEZ) is reserved as breeding ground for fishes hence, only artisanal fishing is permitted in the IEZ. Fishing practices such as the use of explosives, electrical devices, chemicals and associated activities which will cause damage to the marine environment are prohibited in the waters of Sierra Leone. Fishing gears and fishing techniques used should be environmentally safe.

3.7.6 Legal Factor:

The Sierra Leone Fisheries Act is the sole instrument used to regulate all fishing activities. Any fishing activities conducted in violation to the Fisheries Act is considered an offence. Fishing vessels are not permitted to conduct fishing activities

in the waters of Sierra Leone without a valid certificate of registration. Further, the authorization of the Director of Fisheries must be obtained prior to importation, construction, or acquisition of a new fishing vessel or gear, or conversion of a vessel into a fishing vessel in order to manage the fishing capacity.

4 RESULTS AND ANALYSIS

This chapter presents the results of the research questionnaires. The findings are then highlighted, and a discussion of both the results and the findings is made. Analysis of both the results and findings are made with respect to how socially and economically illegal fishing has affected Sierra Leone in particularly the artisanal fishers.

It is important to note that data availability on IUU fishing has been an uphill task due to deliberate efforts made by illegal fishing operatives to conceal information about their activities. However, using arrests made in the EEZ of Sierra Leone (through MCS operations) as proxy for estimating or quantifying the catch taken away by illegal fishing vessels gives an insight about the extent of the act.

4.1 General Comments on the Data Collection Process

Six organisations including the Sierra Leone MFMR, Sierra Leone Navy, SLMA, JMC, Sierra Leone Marine Police and SLAFU were the target respondents for this research. Getting these units to participate in this research was quite difficult due their busy schedules. Additionally, it was also quite a challenge to have these units release certain data due to their information management policies.

Most of these units/organisations do not have electronic data base, and therefore use the traditional filing system to store/keep information. Due to the vulnerability of paper to wear, tear, and misplacement, some respondents reported the loss of some data over the period. Hence, a patchy data was received. This will account for some margin of errors in this research.

4.2 Industrial Fishing Companies Registered in Sierra Leone

Table 4 below shows the 2017 list of registered industrial fishing companies. The Sierra Leone Fisheries Act, 2017 requires fishing vessels to do a regular monthly landing of at least 20 percent of their catch. And it is the responsibility of the company to inform the appropriate authorities when such landing is taking place. It is

interesting to note that all the fishing companies are registered in Sierra Leone, but of the vessels they operate are engaged in distance water fishing and do not come to port to discharge their catch (from Author`s experience). In fact, the Author of this research was a patrol commander in the Sierra Leone Navy from May 2017 onto August 2018. The Author conducted several MCS patrols during this period, but some of the vessels operated by some companies in Table 4 were never contacted, nor did they come to port to land fish. This is a significant loss to the country which can only be estimated by proxy.

Table 4: List of Registered Industrial Fishing Companies in Sierra Leone (2017)

Names of Fishing Company	Number of Fishing Vessels Operated
Okey Fishing Company	24
Annsenkai Fishing Company	47
Africa Yuhai Fishing Company	8
Combra Fishing Company	6
Sierra Fishing Company	19
Tima Fishing Company	11
Peninsular Fishing Company	9
Sabco Fishing Company	8
Sonit Sierra Leone Ltd	3
Total	135

Source: Ministry of Fisheries and Marine Resources 2019.

4.3 Overview of the Offences Committed in the EEZ

Figure 4 below shows a data from the Sierra Leone Navy for some offences committed by the industrial fishing vessels over the last decade. The offences include; fishing without observer, fishing without license, fishing with undersized net, transshipment/export with permit, fishing in the inshore exclusive zone (IEZ, that is depth less than 15 metres), The bars indicate the frequency of arrests for the offences. It can be seen that arrests made for fishing with undersized net has the highest frequency. Most vessels arrested for fishing with undersized nets also did not have observers onboard. In some cases, even though an observer was onboard, but the vessel still used undersized fishing net. Also, some vessels arrested for

transshipment without permit, also fished with undersized net. It implies that the vessels are engaged in committing more than one offence.

In order to estimate the economic impact of IUU fishing by just one industrial fishing vessel the following assumptions are made below:

1. The average fish holding capacity of the industrial fishing vessels is 100tonnes.
2. This catch is made every month.
3. The fishes caught are good-fish (high value fishes such as Snapper, Pollock and many others are referred to as good-fish in Sierra Leone).
4. The cost of good-fish is 2 USD per kilo (price in 2017)

The economic loss will therefore be 200,000 USD (100tonnes x 1000kg x \$2/kg) for just a single vessel in one month. So, in one year the economic loss will be 2,400,000 USD (200,000USD x 12months). This implies that 2.4 million USD will be lost per vessel annually if they are not prevented from doing illegal fishing. So, the greater the number of vessels engaged in illegal fishing the more the losses. This even the case, as in Figure4 it is seen that the frequency of various offences committed fishing vessels is high.

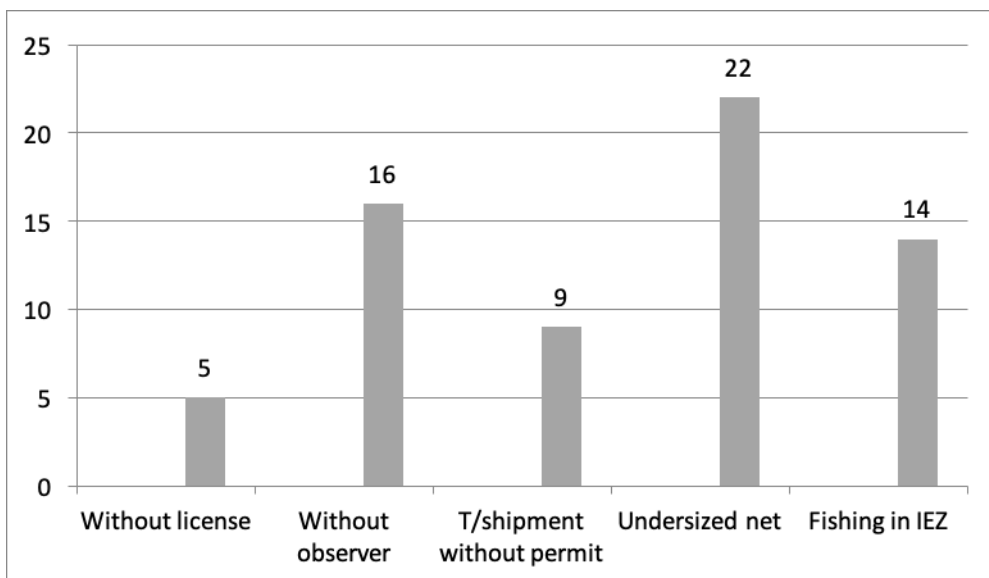


Figure 4: Some Fisheries offences committed by industrial fishing vessels in the last decade.

Source: Data obtained from the Sierra Leone Navy and the Joint Maritime Committee.

4.4 Number of Arrest for the Last Decade (2009-2018)

A comparison of yearly arrests from 2009 to 2018 is made in Figure 5 below. It can be seen that more arrests were made in the first half of the period (that is from 2009 to 2014) than in the last half. That happened because the Sierra Leone naval offshore patrol boat was serviceable during that period. At the same time, the offshore patrol boat of the Sierra Leone MFMR had just been commissioned and fuel was provided to these two offshore patrol vessels for regular MCS operations. However, due to the outbreak of the Ebola virus epidemic in the mid of 2014, the country faced economic slowdown; hence providing bunker for the operations of the offshore vessels became a challenge to the government. Secondly, the naval offshore patrol boat became unserviceable in the second half of the period, and resource allocation for her repair was not a priority, and therefore she was decommissioned. That affected MCS patrols which accounted for the low arrests in the last half of the period (that is from 2015 to 2018).

It is important to note that regular MCS patrols prevent fishing vessels from engaging into illicit activities. So, a decrease in patrols increases the chances of illegal fishing activities to take place thereby leading to economic losses to the nation.

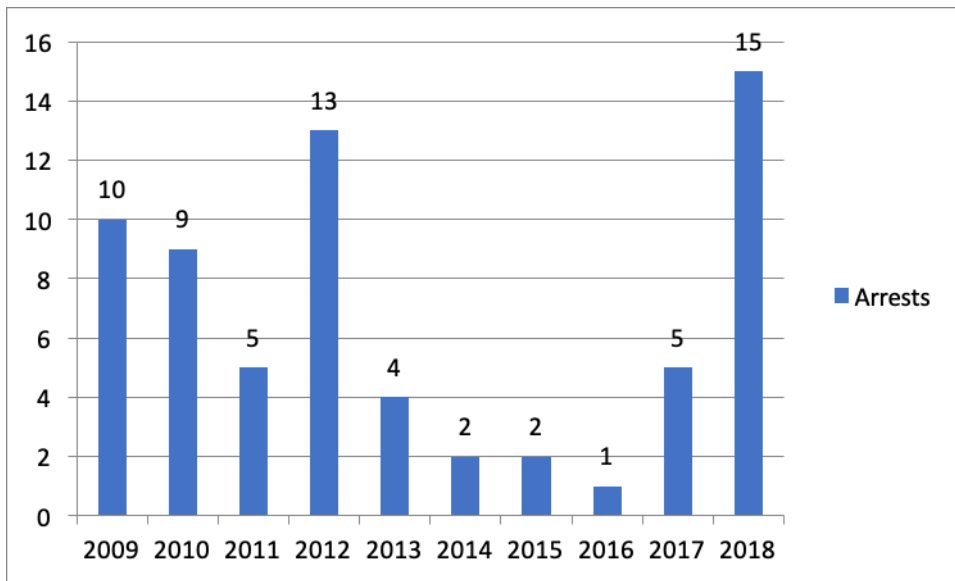


Figure 5: Number of vessels arrested per year from 2009 to 2018.

Source: Data received from the Sierra Leone.

4.5 Estimation of the Probable Impacts of Illegal Fishing in the EEZ

In this section, both the probable minimum impact and the probable maximum impact of illegal fishing on Sierra Leone are estimated.

4.5.1 Minimum Probable Impact

Table 4 below shows some of fishing vessels arrested from 2009 to 2018 in the EEZ. At least 66 industrial vessels were arrested during the mentioned period.

The table 5: Number of industrial fishing vessels arrested for the last ten years

FISHERIES OFFENCES	Number of Vessels Arrested from 2009 to 2018										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Fishing without license	1	X	X	2	X	X	X	X	1	1	5
Fishing without observer	2	3	X	2	1	1	2	X	1	4	16
Transshipment/Export without permit	1	1	X	5	X	1	X	X	1	X	9
Fishing with undersized net	3	2	3	3	1	X	X	X	2	8	22
Fishing in the IEZ	3	3	2	1	2	X	X	1	X	2	14
Total	10	9	5	13	4	2	2	1	5	15	66

Source: Data received from the Sierra Leone Navy.

X = data not provided. IEZ means all waters 5 to 7 nautical miles seaward from the base line

The average capacity of trawlers operating in the EEZ is 100tonnes. So, using the formula below- which has been earlier stated in the methodology for estimating the total impact (that is the minimum probable quantity poached):

$$I_t = V_c \times N.$$

Where I_t minimum probably quantity poached, V_c is the fish catch holding capacity (in tons) per vessel and N is the total number of vessels arrested from 2009 to 2018 (from Table 4, vessels arrested were 66).

So, $I_t = 100 \times 66 = 6,600$ tons.

Hence, the probable minimum quantity poached from 2009 to 2018 is 6,600 tons

Now, in 2018 December, a kilo of fish cost about 2 USD (from Author`s experience). So, the total impact in USD is; $6600 \times 1000 \times 2 = 13,200,000$ USD.

Hence the minimum probable economic impact of illegal fishing in the EEZ of Sierra Leone for the last ten years is 13.2 million USD.

This would mean that on average, Sierra Leone stands to lose a probable minimum sum of about **1.32 million USD to illegal fishing** per year, which amounts to 0.035% of the country`s GDP given that the GDP was 3.74 billion USD in 2017 (countryeconoy.com, n.d). This value might seem to be moderate, but to a country like Sierra Leone (which is ranked as one of the poorest countries of the world), this

would mean a lot. It should be noted that the estimate assumed that the vessels are of uniform capacity and at full load at the time of arrest for the sake of ease of calculation. In practice this may not be the case. However, most of the arrests used in this estimate are those made by the navy. Greater percent of arrests made by the Sierra Leone MFMR during this period are not included in the estimation as data were not provided. Thirdly, the calculation does not include sighting. Hence, the estimated quantity of fish poached during this period is actually an under estimate, and the impact is considered as the minimum economic impact of the illegal catch.

As mentioned in the methodology chapter, the method used in this estimate is called the Bottom-up approach. Given the very nature of IUU fishing, information is both very patchy and hard to collect, and therefore some illegal catches cannot be captured. Hence, the bottom-up approaches are considered to provide minimum estimates for IUU catch (MRAG, 2015).

4.5.2 Maximum Probable Impact

To estimate the probable maximum value of illegal catch, the top-down approach is used (see chapter 3). The top-down approach estimates illegal catch by taking a certain percentage of the total legal catch of all vessels for a given period to be illegally caught. MRAG 2015 uses 19 percent of legal catch over a certain period to be the value of the illegal catch. In 2018, 120 industrial fishing vessels were licensed to fish in the EEZ. From the Author's experience, it takes a about a month for an industrial fishing vessel to fill its holding capacity. So, the maximum probable annual catch of the said registered vessels in 2018 = $120 \times 100\text{tons} \times 12 \text{ months} = 144,000\text{tonnes}$. Applying 19 % to this, total possible catch will give 27,360tonnes. This means that in 2018 a maximum of 27,360tonnes of fish would have been illegally caught as per MRAG 2015. In 2018, a kilo of fish cost 2 USD (Author`s experience). So, the maximum probable value = $2\text{USD} \times 27,360\text{tonnes} \times 1000\text{kg} = 54,720,000 \text{ USD}$. Hence, in 2018 the maximum probable loss for Sierra Leone due to illegal fishing was about 54.7 million USD. This does not take into account the fact

that undersized fish are being caught which is an unsustainable practice that compounds the economic losses besides the deprivation of future generations of livelihood and economic opportunities.

This amount is in line with an EU estimate which indicates that Sierra Leone is losing more than 29 million USD annually to illegal fishing as quoted by the Sierra Leone MFMR on their webpage in 2019 (Sierra Leone MFMR, 2019). This amount is also phase with a report from Stop Illegal Fishing (July 2018), which indicates that Sierra Leone is losing an estimated 50 million USD annually to IUU fishing. For a country like Sierra Leone which is ranked at the bottom of the human development index and where 70% live below poverty line (UNDP, 2010) this amount is alarming.

To further corroborate the findings and provide deeper insight on the above estimates, some fishermen were asked to express their views on the extent of illegal fishing in Sierra Leone. This is as discussed in the next section.

4.6 Views of Fishers on the Extent of Illegal Fishing

Figure 5 shows views of 10 fishers (from three different fishing communities) on the extent of illegal fishing in the EEZ. They were asked to indicate the extent of illegal fishing under the following headings: (a) very serious (value greater than 20 million USD) (b) serious (value between 6-20 million USD) (c) moderate (value between 1-5 million USD per year) (d) Insignificant (value less than 1 million USD per year). Eight of the respondents said illegal fishing is serious in the EEZ, whilst only two said it is very serious. This indicates that illegal fishing is on the increase and there is a probable significant loss of revenue which could be used for economic development.

The sample size may be small and may not give a true representation of the views of the wider fishing community in Sierra Leone on illegal fishing. However, it gives an insight about the degree of seriousness of IUU fishing in the country.

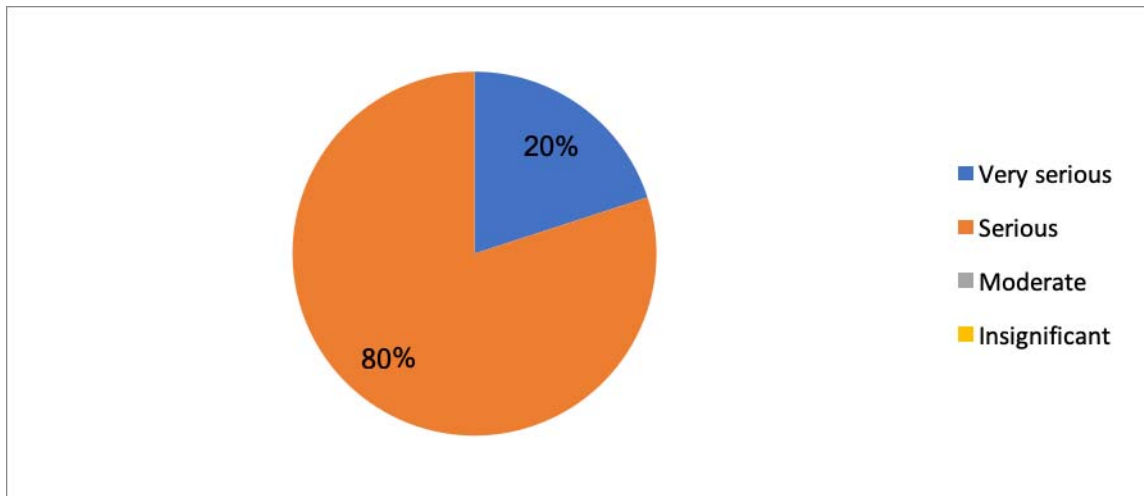


Figure 6: Views of Fishers on the extent of illegal fishing in the EEZ of Sierra Leone.

4.7 The Cost of MCS Efforts in Sierra Leone EEZ

The Navy and the MFMR are the two entities engaged in MCS operations in the EEZ. The major input considered in this research for estimating the cost of MCS operations is fuel. The effort for MCS operations with respect to fuel was provided by the Navy. Data regarding fuel consumption for MCS operations conducted by the MFMR for the last ten years was not provided. However, an ideal case of one patrol per month and a consumption of 1,500 liters per patrol was used to estimate the fuel consumption of the only patrol boat of the MFMR (from hint given by the crew).

The Navy plans 50 patrols per month which are conducted by its six Forward Operational Bases (FOBs) namely; FOB Bailor, FOB Tombo, FOB Gbangbatoke, FOB Bonth, FOB Sulima and the Murray Town Naval Base which are all located along the coast. Each of the FOBs has one Inshore Patrol Craft (IPC) used for conducting MCS patrols. The consumption of the Navy and the MFMR is given in Table 6 below.

Table 6: Fuel Consumed by the Navy and the MFMR from 2009 to 2018

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Fuel consumed in liters (Navy)	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	480,000 Liters
Cost in USD (\$1/litre in Dec 2018)	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	480,000 USD
Fuel consumed in liters (MFMR)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	180,000 Liters
Cost in USD (\$1/litre in Dec 2018)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	180,000 USD
Total cost of fuel consumed by Navy and MFMR in USD	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	660,000 USD

Source: Data from the Sierra Leone Navy.

It is important to note that most of the vessels used for MCS operations are donations from other governments. And therefore, most of the expenditures of the Sierra Leone Government on MCS operations go into fuel. Comparing the loss of revenues due to IUU fishing over the last decade (at least 13.2 million USD lost due to IUU fishing as calculated above) to, the cost of MCS operations (which is about 660,000 USD) over the same period in ratio form, it can be represented as 13,200,000:660,000. This will give 20:1. This means that roughly for every 1 USD spent on MCS operations, 20 USD is potentially saved from prevention of illegal fishing.

While Sierra Leone has a 200-nautical mile EEZ, it is worth noting that the IPCs (inshore patrol crafts) do not patrol beyond 25 nautical miles from shore. Meaning that over 70% of the country's EEZ is not policed. Let say for argument sake, the country invests in tow offshore vessels each costing 2 million USD and with annual fuel consumption of 660,000 USD in order to show regular presence in the EEZ. This will sum up to approximately 4.7 million USD. Comparing this amount to the probable maximum value of illegal catch in 2018 (which is 54.7 million USD as estimated earlier), would mean that if 4.7 million USD would have been invested in MCS operations, a probable maximum value of 54.7 million USD might have been saved from preventing illegal fishing in 2018, and that might have possibly increased the contribution of the Sierra Leone industrial fishing sector to the country's GDP in 2018.

4.8 Contribution of the Industrial Fishing Sector to the Country`s Economy (2010-2018)

Figure 7 below shows the revenue generated by the industrial fishing sector from 2010 to 2018. It can be seen that there has been a steady increase in the revenue generated by the industrial fishing sector in the last decade. This is however not the best as the country is incurring significant losses in its fishing industry as a result of illegal fishing. However, this can be improved by investing in MCS operations.

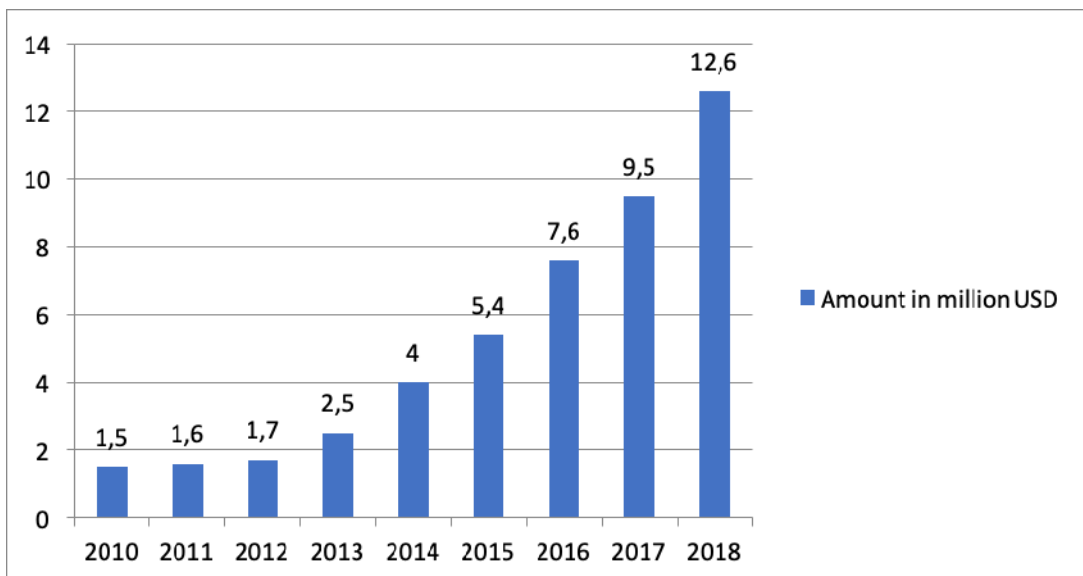


Figure 7: Year-wise revenue generated by the industrial fishing sector (2010 to 2018).

Data received from the Sierra Leone Ministry of Fisheries and Marine Resources.

Figure 7 above shows that revenue generated from the industrial fishing sector is increasing year by year with the highest revenue being generated in 2018. However, if the losses due to IUU fishing were prevented, more revenues would have been realized. Figure 8 below compares the actual revenue generated in 2018 to the minimum and maximum probable revenues that might have been potentially generated if illegal fishing was prevented.

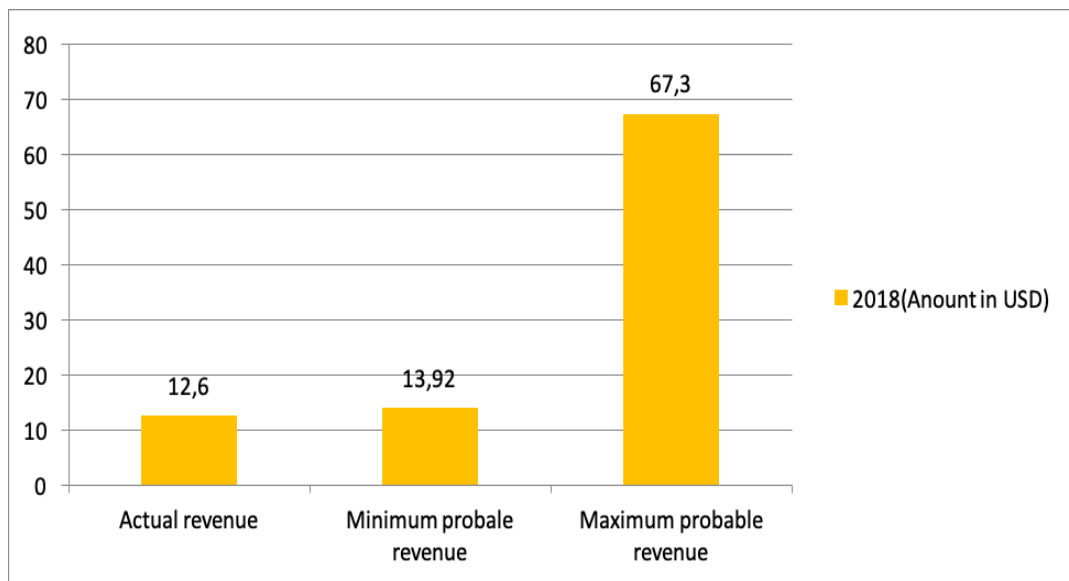


Figure 8: Comparison of actual revenue generated in 2018 to the probable minimum and maximum revenues.

The actual revenue generated in 2018 was 12.6 million USD. However, this research estimates that if IUU fishing was prevented in 2018, the Sierra Leone fishing industry might have potentially generated a minimum and maximum probable revenues of 13.92 and 67.3 respectively. Indicatively, 2018 alone Sierra Leone lose millions of dollars to IUU fishing.

4.9 Social Impacts

This topic presents responses regarding the living conditions of the artisanal fishers and alternative employment, relationship between artisanal fishers and the industrial fishing sector, and the fishing efforts of the artisanal fishers.

4.9.1 Living Conditions of the Artisanal Fishers

Twenty one fishers from three fishing communities namely, Yeliboya, Goderich and Tombo were interviewed about the living conditions of artisanal fishers. They were asked to class the living conditions of artisanal fishers under three headings: (a) Bad (can neither provide 3 square meals nor afford to send children to school) (b)

Moderate (can provide 3 square meals but cannot afford to send children to school)
(c) Good (can provide 3 square meals and afford to send children to school). Their responses are depicted in Figure 9 below. 50 percent indicate that living condition is bad, whilst 30 percent say living condition is moderate, and 20 percent indicate that living condition is good. Additionally, the Sierra Leone Fishermen Association (SLAFU) indicates that majority of the artisanal fishers live in a deplorable condition. Further, he indicated that many fishers live in dilapidated houses that leaks during the raining season, and they cannot afford the repair cost.

This implies that there is a high poverty and as well as high illiteracy level in fishing communities. As most fishers are not able to send their children to school, they introduce them to fishing at a very early age.

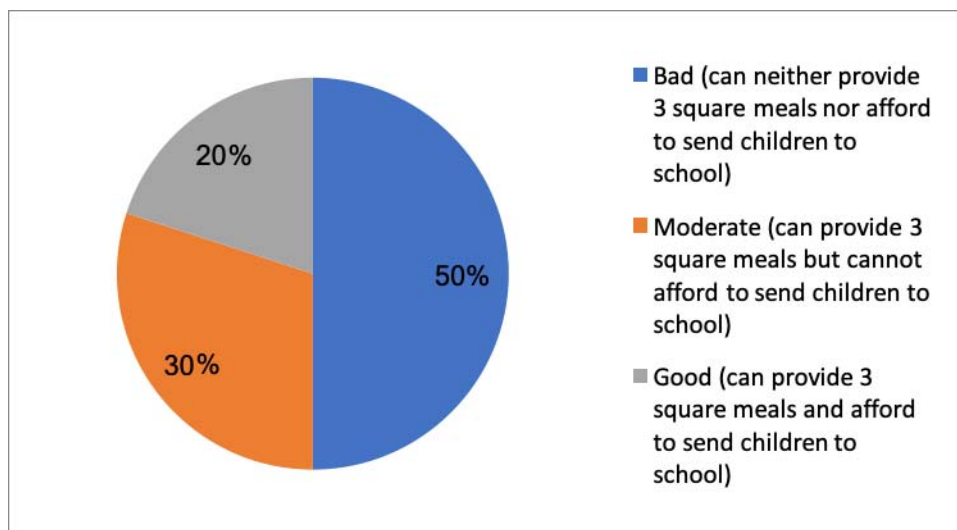


Figure 9: Living Conditions of the Artisanal Fishers

4.9.2 Availability of Alternative Employment

Ten fishers were sampled on the availability of alternative jobs fishing communities. Two indicate that there are alternative jobs are available, whilst the remaining eight say no alternative jobs are available as depicted in Figure 9 below. It is worth noting that majority of the fishing communities only have a few alternative employments. While some fishers are also engaged in petty trading, lumbering is the main alternative employment providing livelihood for some fishers. Locals in the fishing

communities cut down the mangrove forest to produce charcoal used for cooking. However, due to environmental issues a lot of restrictions have been put on deforestation thus, preventing locals from cutting down trees. Other alternative jobs include boat building and boat repairing. However, as more fishers abandon fishing due to low catch, these jobs are not able to absorb them all thereby leading to increase unemployment in fishing communities. And this is a recipe for vices in the fishing communities.

The sample size may be small but it gives an idea about the level of unemployment in the fishing communities as fishers pullout of fishing.

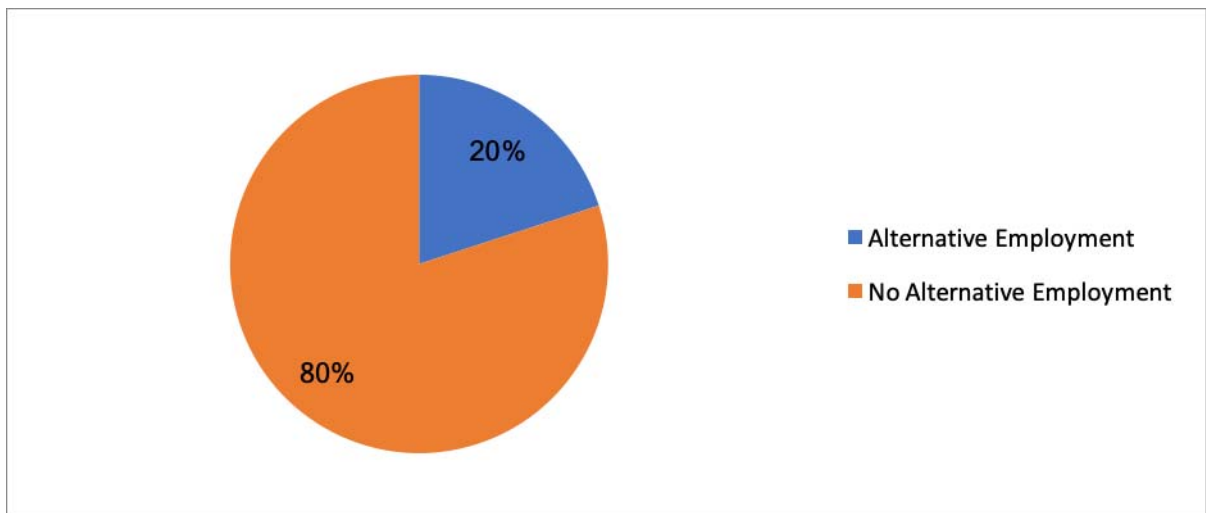


Figure 10: Alternative Employment in Fishing Communities

4.9.3 Fishing Efforts of the Artisanal Fishers

Table 7 shows the efforts fishers put into fishing activities. The capital expenses (fixed cost) include the cost of the boat, cost of fishing gear and the cost of the outboard machine. The variable cost includes cost of fuel.

Table 7: Fishing Efforts of the Artisanal Fishers

Fishing Efforts	
Fuel consumed per fishing trip	90 USD (90 liters at 1USD/liter)
Cost of fishing gear in USD	2,500 USD
Cost of boat in USD	5,000 USD
Cost of outboard machine in USD	2,000 USD
Fishing duration per trip in days	1-2 days
Average revenue from catch per fishing trip	600 USD

Source: Data obtained from the Sierra Leone Association of Fishermen Union.

From Table 7 it can be seen that the inputs of fishers into fishing is very high as compared to the revenue generated and the time consumed per fishing. A typical motorized fishing boat may have at least 8 fishers onboard. Some of the respondents indicated that making a living from fishing nowadays is uphill task as catches are dropping day by day. Some fishers put the blame on the industrial fishing sector as they accused them of overexploiting the fisheries resources through over capacity and illegal fishing.

The sharing pattern between the fishers and the boat owner of revenue generated from the catch is shown in Figure 10 below.

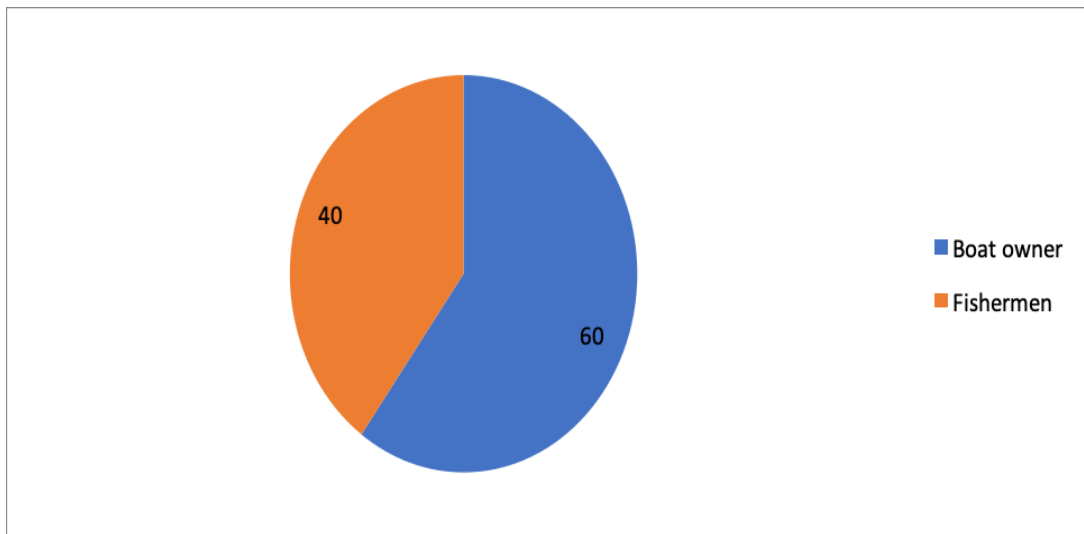


Figure 11: Sharing pattern between boat owners and fishers.

Source: Data obtained from the Sierra Leone Association of Fishermen Union.

From Figure 10 it can be seen that the boat owner gets 60% of the proceeds of the catch, whilst the fishers get 40% after the fuel cost has been subtracted. So, 40% of 600 USD (average revenue per fishing trip) will give 240 USD. Sharing this among eight fishers each will get 30 USD. However, catch currently being all time low, some fishers indicate that in some fishing trips recovering even the fuel cost can be difficult.

4.10 Relationship between Artisanal Fishers and the Industrial Fishing Sector

All the six respondents indicated that the artisanal fishing sector feels adversely impacted by the industrial fishing sector. The Sierra Leon Marine Police revealed that every year they get reports from the artisanal fishers against the industrial fishing sector for destruction of fishing gears, and in most cases the matters are settled by out of court settlement whereby damages are paid by the industrial fishing vessels to the artisanal fishers.

Further, some fishers interviewed are of the view that the industrial fishing vessels are responsible for catch being all time low. They accused the industrial fishing vessels of unsustainable fishing practices. The Marine Police also indicated that

sometime they also get reports from the industrial fishing vessels concerning stone attacks by artisanal fishers on allegations of fishing net destruction. So, there is no cordial relationship between the two sectors as the artisanal fishers see the industrial fishing vessels as being responsible for their hardship. These confrontations at sea have safety and security concerns which need to be addressed.

All the six respondent organisations indicate that the main reason for the confrontation between the two sectors is that they compete for the same fish species and the same fishing grounds. So this leads to a lot of interactions at sea between the two sectors. Appendix 1 and Appendix 2 show some commercially important fish species in the artisanal and the industrial sectors respectively.

4.11 Maximum Sustainable Yield (MSY) of the Sierra Leone Fisheries

Data for specific fisheries species was not provided. However, the MSY of all species in both the artisanal and industrial fishing sector is shown in Table 8 below.

Table 8: Maximum Sustainable Yield (MSY) of all Species

Sector	Production/Yield per Year in tonnes	
	Current production	Potential production
Industrial	15,505	115,600
Artisanal	116,612	46,860
Total	132,117	162,640

Source: Ministry of Fisheries and Marine Resources 2019.

From Table 8 it can be seen that the industrial sector has a greater potential to increase production. This accounts for the reason why production in the industrial sector has been steadily increasing in the last decade. The artisanal sector on the other hand has more than double exceeded its MSY. This explains the reason for the all-time low catch currently experienced in the sector.

4.12 Summary of the Chapter

This chapter used data obtained from questionnaires, interviews and other sources to discuss the economic and social impacts of IUU fishing on Sierra Leone. In the last decade, several arrests were made by the Sierra Leone Navy and the MFMR for several fisheries offences. These arrests were used as proxy to estimate the probable minimum economic impact of IUU fishing on Sierra Leone. The estimate suggests that the probable economic impact of IUU fishing in Sierra Leone from 2009 to 2018 is 13.2 million USD. For such a long period, this amount may seem to moderate. However, when certain assumptions were made in order to estimate the maximum probable economic impact for just 2018, the economic loss was 54.7 USD. This quite alarming, but it is in line with an EU estimate which indicates that Sierra Leone is losing over 29 million USD annually to illegal fishing.

While catch of the industrial fishing sector has been increasing progressively over the last decade, the artisanal sector has been experiencing an all-time low catch. As a result, many artisanal fishers are pulling out of fishing, and there are not enough alternative employments to absorb them. This is leading to unemployment in the fishing communities which affects the livelihood of many fishers.

Most artisanal fishers blamed the industrial fishing vessels to be cause of fish depletion alleging that trawlers are engaged in illegal fishing and unsustainable fishing practices, and sometimes carryout fishing operations in areas designated for only artisanal fishing. This has led to a sour relationship between the two sectors as the artisanal fishers feel negatively impacted by the industrial fishing sector, in particularly so, as according to the Sierra Leone Marine Police, reports of nets destruction are brought by the artisanal fishers against the industrial fishing sector.

5 CONCLUSION AND RECOMMENDATIONS

This research investigated the socioeconomic impacts of IUU fishing on Sierra Leone. In achieving this, the research looked at the contribution of the fishing industry to the global development in general and then more specifically to the GDP of Sierra Leone. And thereafter, the research estimated the economic impact of illegal fishing using proxy.

The improvement in technology in terms of motorization, refrigeration and stock detection has contributed to the worldwide increase of illegal fishing. Literature in this research showed that billions of tonnes of fish are lost every year to illegal. Accordingly, the global fish stocks are collapsing, livelihood are affected, fish food security is threatened. The Marine Resource Assessment Group (MRAG) 2005, and the University of the British Columbia (UBC) 2008, estimated the minimum global value of illegal fish catch is about 4.2 billion USD and 10 billion USD respectively.

At regional level, The West Africa Progress Panel report in 2014 indicated that IUU fishing in West Africa is alarming. More than 50% of the coast stretching from Senegal to Nigeria has now been fully fished or overfished due to illegal fishing leaving many small-scale fishers unemployed. Accordingly, West Africa loses 1.3 billion USD every year to illegal fishing, and Senegal, Guinea and Sierra Leone account for about 1/4th of this amount.

According to an EU report, Sierra Leone loses more than 29 million USD annually as cited by the Sierra Leone MFMR. Over the last decade several fishing vessels were arrested for various fisheries violations. Using these arrests as proxy, it was estimated that Sierra Leone loses a probable minimum value of about 1.32 million USD to illegal fishing every year. Further, the research estimated that Sierra Leone lost a maximum probable value of about 54.7 million USD in 2018 to illegal fishing. Additionally, the research also estimated that for every 1 USD spent on MCS operations, 20 USD will be potentially saved from preventing IUU fishing.

Besides the economic losses, the research demonstrated that IUU fishing has a devastating social impact on the artisanal fishers. Responds from fishers indicated

that the catch of small scale fishers is all-time low, and also rated the living condition of most fishers as bad as most fishers can neither provide three square meals for their families nor send their children to school, leading to high level of illiteracy in the fishing communities. As a result, artisanal fishers are pulling out of fishing and switching to alternative employment. But with lack of adequate alternative employments most fishers remained unemployed.

About 80% of fishers surveyed are of the view that industrial fishing vessels have negatively impacted the artisanal fishing sector. Artisanal fishers accused industrial fishing vessels of engaging in illegal fishing practices such as fishing with undersized net, and fishing in the IEZ which is designated for only artisanal fishing. And many of the respondents rated the extent of illegal fishing in Sierra Leone as serious.

Nonetheless, the Sierra Leone fishing industry has the potential to grow. The combined current production of the sectors is below the maximum sustainable yield. Hence, investing in MCS operations and also implementing good fisheries management policies may minimize illegal fishing and improve the contribution of the fishing sector to the socioeconomic development of Sierra Leone.

5.1 Recommendations

To enhance sustainable fishing and minimize IUU fishing in the EEZ of Sierra Leone, the following recommendations are made:

1. The Sierra Leone Ministry of Fisheries and Marine Resources (MFMR) should establish an electronic data base that captures the daily catch report of all industrial fishing vessels operating in the EEZ. This will help to determine whether the total allowable catch has been exceeded.
2. The Sierra Leone MFMR should establish the maximum sustainable yield (MSY) and total allowable catch (TAC) of all commercially important fish species. This will inform fisheries management policies.
3. The Sierra Leone MFMR and the Sierra Leone Navy should establish a data base of all industrial fishing vessels arrested or sighted for IUU fishing. This will

give an insight about the extent of illegal fishing, and hence inform policy makers about how much investment is needed to carryout MCS operations.

4. The Government of Sierra Leone should provide three offshore patrol vessels with the Sierra Leone Navy which are capable of patrolling the EEZ, in order to show regular presence thereby preventing IUU fishing activities.

5. The Sierra Leone Navy should conduct regular patrols in the inshore exclusive zone (IEZ) in order to prevent industrial fishing vessels from operating in prohibited areas.

6. The Sierra Leone Navy and the Sierra Leone MFMR should closely monitor the landings of all industrial fishing vessels and ensure that all vessels come to port at least once a month to land their catch.

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APPENDICES

Appendix 1: Some Commercially Important Fish Species in the Artisanal Sector.

Scientific Name	Local Name
<i>Ethmalsa fimbriata</i>	Bonga
<i>Arius</i> sp.	Catfish
<i>Caranx</i> spp	Cowreh
<i>Pentanemus quinquarius</i>	Beardfish
<i>Sphyraena</i> spp. (adult)	Barracuda
<i>Pomadasys jubelini</i>	Crocus
<i>Pseudolithus elongatus</i>	Guanguang
<i>Sardinella</i> spp	Herring
<i>Sphyraena</i> sp (juvenile)	Kini
<i>Pseudolithus</i> spp.	Lady-fish
<i>Engraulis encrasicolus</i>	Langa-mina
<i>Ilisha africana</i>	Lati
<i>Pagrus, Dentex, Pagellus</i> spp	Snapper
<i>Raja</i> spp	Skeete
<i>Galeoides decadactylus</i>	Shine-nose
<i>Scomberomorus tritor</i>	Mackerel

Appendix 2: Some commercially important fish species in the industrial fishing sector.

Scientific Name	Local Name
Penaeids shrimp	Shrimps
Arius sp.	Catfish
Caranx spp	Cowreh
Pentanemus quinquarius	Beardfish
Sphyraena spp. (adult)	Barracuda
Pomadasys jubelini	Crocus
Pseudolithus elongatus	Guanguang
Sardinella spp	Herring
Sphyraena sp (juvenile)	Kini
Pseudolithus spp.	Lady-fish
Engraulis encrasicolus	Langa-mina
Polydactylus quadrifilis	Spanish-mackerel
Pagrus, Dentex, Pagellus spp	Snapper
Raja spp	Skeete
Galeoides decadactylus	Shine-nose
Scomberomorus tritor	Mackerel