11-3-2020

The risk of oil spill in the Exclusive Economic Zone of Sierra Leone

Duramani K. Sesay

WORLD MARITIME UNIVERSITY

Malmö, Sweden

THE TITLE OF THE DISSERTATION

The Risk of Oil spill in the Exclusive Economic Zone of Sierra Leone

By

DURAMANI KEMPES SESAY

SIERRA LEONE

A dissertation submitted to the World Maritime University in partial fulfillment of the requirements for the reward of the degree of

Masters of Science

In

Maritime Affairs

(Maritime Safety and Environmental Administration)

November 2020

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): ....

(Date): ....

Supervised by: ....

Supervisor's affiliation.................................

ACKNOWLEDGEMENT

I wish to express my sincere thanks and appreciation to the various organizations and individuals that contributed immensely towards the successful completion of this dissertation

First and foremost, I would like to sincerely thank my supervisor, Professor Ronan Long for his valuable advice, guidance and encouragement throughout the entire dissertation process and to Ms Jill Jarnsater for her support in scheduling our dissertation meetings.

I would like to extend my thanks and appreciation to the entire management and staff of the Sierra Leone Maritime Administration for the support accorded me throughout the period of my study in WMU Malmo, Sweden.

Additionally, my sincere gratitude goes to the management of WMU for offering me a place in the university to pursue the master degree in Maritime Affairs, my sponsors for awarding me a scholarship, and the entire staff of WMU.

Finally I would like to extend my deepest appreciated to my late parents for their love and blessing, to my wife and children for their patience, friends, extended families and relatives for their prayers and thoughts during my studies at WMU in Sweden.

ABSTRACT

Title of Dissertation: **The Risk of Oil spill in the Exclusive Economic Zone of Sierra Leone**

Degree: **Master of Science**

This research study investigated the risk of oil spill in the Exclusive Economic Zone (EEZ) of Sierra Leone. The study's research objectives were: to examine the risk posed by potential oil spills in the EEZ of Sierra Leone; to assess the country's risk classification method for easier risk identification; to assess whether the country has an effective response equipment and supporting resources and to understand the challenges faced to effectively implement the International Convention on the Preparedness, Response and Cooperation (OPRC) in Sierra Leone.

To answer the derived research question, the study targeted 12 major stakeholder institutions responsible for the regulation, importation and transportation of oil products as well as protection of the coastal marine environment as respondent. The study analysed qualitative data collected from respondents through the use of administered questionnaires.

Findings based on Sierra Leone shows that even though the country has an oil spill response plan, it is not well prepared to respond in event of a huge oil spill similar to recent spills in Mauritius and elsewhere. The country as at the time of research, has not recorded any major oil spill, which is very fortuitous. However, the poverty levels and weak health infrastructures in Sierra Leone, a major oil spill outbreak will be catastrophic; as the country is ill prepared to adequately respond to such level of oil spill. The regulatory environment is weak, resources are lacking, and institutional and technological capacity and expertise is also undermining national capability. Implementation of the OPRC is faced with a lot of challenges to be successful. Therefore, the country needs to prioritise the protection of its EEZ and to effectively respond to any event of an oil spill with the needed tools and equipment, technology and human expertise.

KEYWORDS: Exclusive Economic Zone, Oil Spill, Risk, Preparedness, Marine Environment, Coastal Environment, Sierra Leone.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

EEZ	Exclusive Economic Zone
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
GRSL	Government of the Republic of Sierra Leone
IMO	International Maritime Organisation
IOGP	International Association of Oil and Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Federation Limited
NGOs	Non-Governmental Organizations
ONS	Office of National Security

OPRC	International Convention on the Preparedness, Response and Cooperation
PAHs	Polyacyclic Aromatic Hydrocarbons
PHC	Population and Housing Census
SLMA	Sierra Leone Maritime Administration
SLPA	Sierra Leone Ports Authority
SLSA	Sierra Leone Shipping Agency
SSA	Sub-Saharan Africa
UNCTAD	United Nations Conference on Trade and Development
VOCs	Volatile Organic Compounds

CHAPTER ONE – INTRODUCTION

1.1 Background to the Study

Most oil spills are human-induced risk related and for that reason, people and society at large have their expectations, perceptions and scrutiny about it (IMO, 2010).

The backbone of globalized trade and manufacturing supply chain is maritime transport, as more than four fifth of world merchant trade by volume is carried by sea and of which the shipment of tanker trade i.e. oil, gas and chemicals accounts for 29.0 percent in total (UNCTAD, 2019).

Shipping has its own environmental challenges such as pollution from ballast water, sewage, oil discharges, grey water, solid waste and air pollution, apart from the huge economic gains it brings (Singh, et al. 2015). According to Vanem et al. (2008), 24 percent of oil spilled into the marine environment and 80 percent which resulted from normal shipping operations, are caused by shipping and transportation of oil activities at sea. Therefore, the need to have a closer look at the risk of an oil spill is very much important.

Oil pollution as shown in many studies can be devastating, harmful and potentially toxic to marine mammals if not manage adequately (Singh, et al. 2015). A vivid example was the 1978 Amaco Cadiz incident, wherein nearly 20,000 birds were found dead and millions of Molluses, sea urchins, and shell and fin fisheries together with benthic species (Groenhuis, 1981). Again, in the Exxon Valdez disaster, approximately over 1,800 km shores in Prince Williams Sound and along Alaska's South coast as far as west of Kodiak Island were affected in spite of the massive number of vessels and clean up equipment used (Groenhuis, 1981). More recent examples include spills in Venezuela and Mauritius that expose the huge environmental, economic and social toll of developing countries when faced with such destruction and inadequate response.

The International Maritime Organization (IMO) adopted international and regional regulations for pollution from ship in order to ensure oil spill prevention, preparedness and response with principal convention being, Convention on the Prevention of Pollution from Ship (MARPOL), the International Convention on Oil Spill Preparedness, Response

and Cooperation (OPRC) (Singhota, 1995), and these treaties need to be transposed and implemented into national laws and policies if they are to be fully effective.

As a requirement, parties to the OPRC expected to institute measures at national or internationally with other countries for dealing with incidents of pollution (OPRC, 1991). The convention also requires for member states to designate a competent Authority as national operational point of contact for oil spill preparedness and response, established a contingency plan in line with OPRC guidelines and for requesting assistance (Muthike, 2018) in terms of prompt and effective response.

The OPRC conventions, the Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of West and Central Africa and its protocol to which Sierra Leone is a party, requires the adoption and implementation, capacity building and strengthening of a National Oil Spill Contingency plan as stated in the (giwacaf. 2016).

Geography is an important consideration and Sierra Leone has three ports, the Port of Freetown also known as the Queen Elizabeth II Quay, Port of Pepel and Port of Shebro Island. Though loaded tankers in and out of Sierra Leone is relatively small, yet it faced potential threat. Any major oil spill from tankers navigating through the coast of Sierra Leone from Europe and North America in the event of accident, collusion, or grounding could have devastating consequences to the environment and the livelihood of many residents in the coastal areas or actively en gaged in fishing (giwacaf. 2006). Due to their limited resources and economic reliance on the coastal environment, most developed countries are at risk, especially in the area of fishing and tourism (Singhota, 1995). The potential loss associated with certain hazard and relates potential adverse effects to hazardous events, is usually defined as risk (Cardona et al., 2012). Assessment of risk involves both hazard and vulnerability quantification (Al Shami, et al. 2017).

Though oil has been discovered in Sierra Leone, it is still in the exploratory stage and so the country still relies on the importation of fuel oil for domestic consumption. However, when it reaches the exploitation stage and for subsequent export of the crude oil in the future, this in turn increases the risk of spill. Therefore, the risk of oil spill has certainly

10

remained to be a hot topic and requires attention and appropriate responses must be developed by the government of Sierra Leone that are in line with agreed international practices and treaty obligations.

The principal responsible body which is the Sierra Leone Maritime Administration (SLMA) and the Government of the Republic of Sierra Leone (GRSL) are desirous to preserve and protect human health, marine plant and animal and the coastal and marine environment from the risk of oil spills from vessels, terminals, ports and future platforms. The government is also aware of the need to employ all precautions to prevent oil pollution in all waters and in the occurrence of an oil spill to employ prompt and effective measures to ensure that damage to our marine and coastal environment is minimized. In order to prevent damage and protect Sierra Leone's resources, the Sierra Leone Maritime Administration (SLMA) has placed oil spill control and recovery as a priority, with the goal of providing swift, aggressive, and well harmonize response to spill incidents. Baseline study on key species and habitats before spills is necessary. Baseline data may help determine what damage was caused by a spill, the extent of the resource impacts, and to help focus on restoration efforts. Better preparedness and response will lead to a reduction in damages to Sierra Leone's marine ecosystem and organisms from large oil spills. However, the need for a better understanding of the calculated risk an oil spill may pose in the Exclusive Economic Zone of Sierra Leone will optimized the need for better preparedness and to find ways of preventing it is essentially the focus of this research study and the recommendations presented below.

1.2   Statement of the Research Problem

The sustainability of coastal and marine life has been and still remains a major concern globally largely resulting from the large amounts of oil entering into water bodies (Ipingbemi, 2009). According to (Yuewen & Adzigbli, 2018) the extraction and transportation of crude oil and gas continues to be a major threat to the marine environment and causes severe and long-term destructions to marine and coastal ecosystems as well as the organisms that sustains them. The immediate causes of oil spillage according to (Mobil Producing Nigeria, 1998 as cited by Ipingbemi, 2009) includes: break-up of pipelines or damage to or leakage of oil pipelines, oil tank

overflow; rupture or failure of loading, floating or under-busy hose; broken flange connections or flow lines as well as the transportation process of crude oil through pipelines or tankers from one destination to another. Additionally, oil spillages is also caused by cleaning operations, malfunction of sea valves, carelessness during connecting and disconnecting of hoses and failures to observe standard guidance operating rules (Ipingbemi, 2009).

In Sierra Leone, the **Invalid source specified.** reports that pollutants entering the seas of Sierra Leone are mostly from the following sources: 44% accounts for water runoffs from the land into the sea; 33% relates to the atmosphere; 12% are as a result of spills, operational marine transportation and discharge; 10% are from dumping wastes directly into the sea and 1% related to offshore activities of mineral resources.

Globally the major causes of tanker oil spills (i.e. > 7 tonnes) are attributed to allusion/collision accounting for 30%, ground 32%, hull failures 13%, equipment failures 4%, fire/explosion 11% other 7% and unknown causes accounting for 3% (ITOPF, 2019). The ITOPF report notes that events inclusive of heavy weather damages and human errors are categorized under 'other' while those that lack relevant supporting data are categorized under 'unknown'. The report further reveal oil spill incidents recorded in 2019; which includes: one large spill (> 7 tonnes) and two medium spills (7-700 tonnes) which occurred in North America (vessel collision) and South Asia (one collision and the other sank in circumstances that is yet to be known). Thus, 2019 witnessed approximately 1,000 tonnes of oil lost to the environment, the same as was recorded in 2012 and the lowest figure recorded for the last five decades (ITOPF, 2019).

The consequences of oil spills are detrimental, leading to massive pollution of land, rivers and streams across nations. For instance, in the Niger delta region of Nigeria, oil spills have destroyed the aquatic environment as well as the ecology that serves as a major resource for the people. This situation makes the land unsuitable for agricultural production making the lives of citizens more deplorable (Ipingbemi, 2009). Further consequences are a loss of mangrove trees due to their inability to withstand high toxicity. Oil spills have been recorded to have adverse effects on marine habitat that also

poses significant risk to human health resulting from the consumption of contaminated seafood (Twumasi & Merem, 2006).

These effects according to (Ogbogbo, 2004) have the tendency of moving people away from their traditional economic activity without providing them any viable alternative; and in the long-term hunger, joblessness and increased community poverty will become more visible in an already poverty driven community. As mentioned above, the unforgiving nature of spills in Mauritius and Trinidad and Tobago expose the dangers to developing countries. This study therefore seeks to explore the risk of oil spills in the Exclusive Economic Zone of Sierra Leone.

1.3 Aim and Objectives of the Study

1.3.1 Aim of the Study

The aim of this research is to identify the risks of oil spill in the Exclusive Economic Zone of Sierra Leone with the view to strengthen preparedness and response to oil spill incidents

1.3.2 Objectives of the Study

1. To examine the risk posed by potential oil spills in the Exclusive Economic Zone of Sierra Leone
2. To develop a risk classification method for easier risk identification
3. To have an effective response equipment and supporting resources
4. To assess the difficulties and obstacles of effective implementation of the OPRC in Sierra Leone

1.4 Research Questions

Below is the research question:

1. What is the calculated risk of an oil spill in the Exclusive Economic Zone of Sierra Leone?

1.5 Significance of the Study

This research explores the various risks associated to oil spills especially within the economic zone of Sierra Leone. It will bring into perspective the environmental impact within the coastal marine environment ecosystem thereby contributing to the work of the

13

Government of Sierra Leone, the Environmental Protection Agency (EPA), the Sierra Leone Maritime Administration (SLMA), and the Petroleum Agency amongst many on the causes, risks and immediate response to oil spillage. Furthermore, it will significantly contribute to the limited available literatures on the subject specific to Sierra Leone thereby adding knowledge to the already existing body of knowledge on oil spillage, environmental degradation and response.

Additionally, the study will provide in-depth level of awareness amongst relevant authorities and citizens together with practical recommendations that would be useful for implementation in the short-term and in the future by policy developers and implementers.

1.6 Research Methodology

The primary research method for this study is largely based on a qualitative research method in order to satisfy the objectives of this dissertation. Identifying the possible causes of oil spill and classification for easier risk identification would be the starting point towards a zero risk environment. The study reviewed in the first place the potential risks of oil spill in the Exclusive Economic Zone of Sierra Leone and based on the findings, classify those risks for easier identification. The next part of the study consists of the susceptibility of Sierra Leone and evaluated by looking at proofs of oil spill disasters discussed in literature of some research works on the marine environments and the need to have an effective response equipment and supporting resources. Furthermore, having classified the risks identified, the study assesses the difficulties and obstacles of effective implementation of the OPRC in Sierra Leone.

The study targeted respondents from the following institutions in Sierra Leone; the Environmental Protection Agency (EPA), the Sierra Leone Maritime Administration (SLMA), the Ministry of Fisheries, the Petroleum Directorate, Sierra Leone Ports Authority (SLPA), Sierra Leone Shipping Agency (SLSA), Maersk Line, Non-Governmental Organizations (NGOs), Local authority such Paramount Chief, Civil Society the Metrological Agency and Office of National Security (ONS) using the purposive sampling technique. A total of 12 respondents were reached for the study.

Finally, the study proposed recommendations on oil spill risk on the Exclusive Economic Zone of Sierra Leone.

1.7 Scope and Limitation of the Study

1.7.1 The Scope of the Study

Time scope: The research work spanned the period 2000 - 2018. This period provided the researcher with the most recent information available on the research topic.

Content scope: The researcher examined research works of not more than 10 years when looking at concepts and theories with exception of where classical works were used. The researcher reviewed empirical researches below 10 years. This scope of content provided the researcher with the most current, relevant and useful information for the research study.

Geographical Scope: The research was carried out in Sierra Leone

1.7.2 Limitations of the Study

In the course of carrying out this research study, the research was faced with the following challenges:

Firstly, there exist a limited number of journals, empirical research and reports publications specific to the context of Sierra Leone, thus making it very difficult for the researcher who was left with no other option but to use literatures relating to other African countries such as Nigeria.

Also, the researcher was faced with significant challenge in getting clearance for the release of relevant data in good time from government institutions in Sierra Leone, who are mostly bureaucratic in structure. Another limitation to the study relates to financial resources as the researcher had to travel to the ground in order to collect data, and this requires huge travelling, accommodation, food and insurance cost.

Again, research respondents possess another significant challenge as some of them were very busy due to the nature of their work, others were requesting for payment while some were just not interested in participating in the research study even when though the

purpose of the study was clearly explained to them. The coronavirus disease and lockdown in Sierra Leone brought also its own challenges, as flights were cancelled and people had to be quarantined for fourteen (14) days. As such the researcher had to use a small sample size for statistical measurement for which a study of this nature is a limitation, as the larger the sample size the better the research outcome. On the other hand, this weakness is mitigated by the qualitative nature of the survey and the comprehensive engagement by a number of the respondents.

1.8 Organization of the Work

Chapter one constitutes the introduction which focuses mainly on the background of the study, statement of the problem, objectives of the study, the research questions, significance of the study, research methodology, scope and limitations of the study, and organization of the study.

Chapter two reviewed literatures from different authors on the risk of oil spill in the economic coastal zones of nations across the world. It also reviewed literatures on the preparedness of response mechanism.

Chapter three on the other hand, describes the research methodology that includes a brief description of the research design adopted for the study, a description of the research area, target population, sampling procedures or techniques, research instruments, data collection procedures, data analysis techniques and ethical issues.

The **fourth chapter** presents the quantitative analysis and its interpretation, while **chapter five** contains the discussion of findings based on the objectives of the study and data analysis and draw conclusions on the major findings, provide recommendations and suggestions for further study.

CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction

Risk of oil spill in Sierra Leone represents a serious threat to the coastal environment.

Oil spills resulting from extraction and transportation of crude oil has been, and will continue to be, an overriding threat to our marine ecosystem. Oil's multifaceted use in transport, energy and manufacturing makes it vital to the growth of modern economies over the past 35 years which has led to an increase in energy demand by 7 fold worldwide, contributing to an increase in gross domestic product (GDP) (Bryne, 2019).

Research as has shown that countries are at risk of oil pollution by tankers destined to other countries which navigates through their coastal waters and not only by tankers calling at their ports (Moller, et al. 2003). Apart from oil tankers, there are also cargo ships entering the exclusive economic zone of Sierra Leone. Data on the number of ships going in and out of the port is necessary to ascertain the traffic, navigational aids can play a vital role in terms of maritime traffic flow. Sierra Leone has one major port called Queen Elizabeth II Quay port, which is the main port for import and export of goods and petroleum oil. There is also export of minerals such as Rutile and Iron ore carried out by the mining companies.

Most communities are at risk of oil spill disasters and must anticipate and prepare, as increase in oil transportation worldwide continue to increase. Specifically, the risk of accidental oil spill occur mostly during the transportation of oil from production sources to final consumption which can result to severe damage to the marine ecosystems and human loss in society (Chang, et al. 2014). The distribution of oil, using remote sensing images are essential as confirmed by similar studies on the trajectory of oil spilled estimation of environmental and economic damage cause by pollution (IMO, 2010).

Due to the fact that petroleum hydrocarbons are toxic to all forms of life and harm both aquatic and terrestrial ecosystems, environmental pollution caused by petroleum has emerge to be of great concern (Saadoun, 2015). However, petroleum hydrocarbons are not the only issues that have emerge as great concern to the marine environment. Chemical substances on board ship can be of great hazards if there is an accident.

According to Chang, et al. (2014), one of the most important predictors of impact when a spill event occurs, is its location and further states that what are more expensive to clean and also have greater economic impacts is spills closer to shore and human populations.

Notwithstanding, spills such as the Macondo oil Spill that occur in the gulf of Mexico and the grounding of the Exxon Valdez in Prince William Sound, Alaska, USA on March 24, 1989 that spilled 10.8 million US gallons of crude oil that occur offshore (Seager, et al. 2007) has revealed that they were also expensive to clean and also caused devastating environmental disasters.

Oil initially disperses out and moves on the water surface as a slick when it spilled at sea (Saadoun, 2015). He went on to state that oil moves with the wind and current and its a few millimetres thick and goes through a number of chemical and physical changes concurrently, and further went to states that the action of winds, waves, water currents, oil type and temperature, cause marine oil spills spread. The economic coastal activities and the communities that exploit the resources of the sea as well as marine life can be impacted if there is marine oil spill, he went on to explain. Coastal areas such as beaches that attract tourism and pleasure, fishing communities and many more can truly be impacted by oil spill.

Therefore, it is necessary that countries conduct risk assessment in order to identify possible scenarios for proper oil spill risk mitigation. What can go wrong at a defined interval and what the consequences will be if it does, is the determination of risk assessment (Al Shami, et al. 2017). It is therefore paramount to ascertain the event that could possibly lead to an oil spill, together with the resulting impact they assert.

This chapter therefore, reviewed the risk of oil spills with reference to it environmental, socio-economic and health risk to individuals, communities and the nations. It then progresses to review the response mechanisms with respect to oil spill response methods, equipment and resources – it examined the traditional and advance method and response equipment's. The chapter ended with an examination on the challenges developing countries face with implementing the Oil Pollution Preparedness, Response and Co-operation Convention (OPRC) and some suggested recommendations based on previous studies.

2.2 The Risk of Oil Spills

According to the (ITOPF, 2011), an oil spill refers to the release of a liquid petroleum hydrocarbon into the environment due to human activity; the term often refers to marine oil spills. Hulsey & Ludivina (2012) went on to include the discharge of crude oil from tanker ships, spillages from petroleum ships and even those from heavier fuel tankers as the spill of any oily white substance refuse or waste oil. Ifunanya (2010), on the other hand assert that oil spillages are also form of industrial pollution resulting from exploration and transportation of petroleum related products. Considering oil spillage as oil pollution, the United Nations Convention on the Law of the Sea defined pollution as the introduction by man, directly or indirectly of substances or energy that affects the environment and has consequences on humans, other living things and there living environment (Article 1. UNCLOS).

The negative impacts of oil extraction by oil companies remain a major concern across African countries, especially Sub-Saharan Africa (SSA) as it threatens the health and livelihoods of communities (European Parliament, 2011) and the continent. This section reviews the environmental risk of oil spill, the socio-economic as well as the health risk associated to oil spills.

2.2.1   Environmental Risk of Oil Spill

Oil spills have led to massive environmental degradation in the past decades (Ekwugha, 2014). According to (Badejo and Nwilo, 2008) oil spills have led to the contamination of water bodies, destruction of aquatic life, flora and farmland which includes resort centres, destruction of community and individual properties and worse of all is the loss of animal and human lives.

In a study on the "environmental impacts of oil exploration and exploitation in Niger delta of Nigeria" by (Ayuba, 2012) asserts that oil exploration has led to disastrous environmental impact and seriously affected the lives of people living within the region. The risk of oil spill is evidence in contaminated streams and rivers, forest destruction and biodiversity loss leading ecological wastelands. Ayuba, went on to argue that, oil spills significantly affects the livelihood of the locals who mostly depend on the natural

resources within the ecosystem for their survival thereby increasing the rate of poverty in the region.

In another study within the same region by (Omorede, 2014) argues that the exploration of oil leads to chemical and seismic wave generation which is major source for environmental degradation resulting from oil spills and gas flaring. The study went on to explain that petroleum oil spills makes the soil infertile, it burns the vegetation and kills soil organisms thereby affecting the overall output of agricultural products.

The risk of oil spill is not limited only to the agricultural lands, but it also affects the marine organisms and the living environment. A major long-term concern for the environment is that; oil spills last long after incident has occurred without proper action taken with regards clean-up and proper remediation. Even where proper remediation actions are taken, it takes up 15 years for proper recovery of the environment (Ayuba, 2012; Omorede, 2014).

2.2.2 Socio-economic Risk of Oil Spill

According to (Lee, 2011) when an oil spill occurs several stakeholders have different interest priorities for instance, the scientist maybe concerned with ecological issues, whereas; government, corporations and entrepreneurs are concerned with economic issues resulting from oil spills. They are concerned with issues such as loss in tourism revenues, reduction in property values and other emerging opportunity costs. Lee, went on to assert that residents as well as businessmen are also concern especially about the future of economies that the ocean is a major resource.

According to (ITOPF, 2011) tourism is a key economic activity in most coastal areas around the world, however; oil spills disruptions in traditional activities such as "bathing, boating, angling, diving among others are seriously affect. This leads to a huge loss in revenues for businesses in the tourism sector. For instance, a report by (Richardson & Brugnone, 2018) argued that when the quality of water is polluted at beaches, this may drive away potential visitors to other locations in search of recreation thereby resulting in revenue loss for the affected beach. This situation was further discussed by (Larkin et al, 2013) as leading to a decline in tourism resulting from the perception of contaminated

coastline while residential property values also decline due to the associated stigma of a polluted environment.

In the absence of limited data on oil spill, other countries examples are used in order to relate the risk an oil spill may pose in the Exclusive Economic Zone of Sierra Leone.

Studies in Nigeria, reports that the socio-economic effects of oil spill are seen in the loss of agricultural land for farming, rise in cost of living, and a general increase in crime and violence related activities (Chindo, 2011). Owabukeruyele (2009) moved further to explain that oil spills threaten the already weak subsistent peasant economy and biodiversity thus impacting on the socio-economic means of livelihood s of inhabitants. Another, study from Ghana reports that discovery of oil was faced with resulting fears in socio-economic political stagnation, potential for conflict and overdependence of the nation's economy on oil production (Obeng, 2010). Thus, it is believed that oil spills threatens the already weak subsistent peasant economy and biodiversity thus impacting on the socio-economic means of livelihood s of inhabitants.

Another issue of concern in Nigeria for instance, has to do with oil theft, which exposes the future risks to Sierra Leone should the industry develop in such a manner. For instance, oil theft has been reported to be of a significant threat to the country's' economy. According to (Obanade and Amangabara, 2014) in their study reported an estimated 150,000 barrels of oil theft through various pipelines in the Niger Delta region. However, Shell Company limited accounts that 75% of its loss are as a result of oil spill and vandalism; more especially about 300,000 barrels were lost per production day as result of vandalism being the major reason (Shell, 2014). The Table below shows reports on the economic consequences of oil theft to the Nigerian economy.

Table 1: The Consequences of Oil theft in Nigeria

Incidence	Consequences of Oil theft in Nigeria
Average death	The continuous unrest an agitation by the militants has led to deaths of many citizens of the country. At its peak, over 2,000 people were killed in the struggle between the government and

	the indigenes.
Loss of biodiversity and environmental effects.	Illegal oil theft has a devastating effect on the environment, from the pollution of potable drinking water to death and loss of biodiversity's such as fishes, plants and other living organisms present in the environment.
The public implication of oil theft to the government.	The federal government of Nigeria estimated that in 2010 and 2012 alone, it spent up to $2.3 billion dollars on pipeline security and repairs.
The estimated worth of oil theft Fuel scarcity and public increase in fuel price	The federal government of Nigeria claimed it loses about 3 to 8 billion dollars to oil theft and illegal bunkering (Katsouris and Sayne 2013). There had been subsequent incidences of fuel scarcity across the country; this had been majorly caused by vandalism and oil theft.

Source: Katsouris and Sayne, (2013) as cited by **Invalid source specified.**

2.2.3 Health Risk of Oil Spill

According to (Ekoh, 2015) "water and air pollution are an important source of illness to humans depending on the level/degree of exposure". Citing the works of (Colborn, et.al 2011; O'Rourke and Connolly, 2003); (Ekoh, 2015) explains that oil and gas production affects the environment and human health due to the excessive exposure of harmful emissions occurring through spills in production and transportation processes. Oil spills are reported to contain Volatile Organic Compounds (VOCs), Polyacyclic Aromatic Hydrocarbons (PAHs), heavy metals and dispersants (Lee, 2011); these are harmful to humans as they are carcinogenic (Al Fartoosi, 2013).

Research work by (Hou, Zhang, Wang, & Baccarelli, 2011 as cited by Sako, 2017) puts global death attributed to environmental pollution very year at 13 million deaths.

Indicating the level of seriousness of the effect of oil spills on human health. Oil spills are recorded to have adverse health risk to only to people living within the communities, but also to those involved in the clean-up operations of coastal inhabitants as a result of the toxicological properties found in oil components (Laffon, Pasaro, & Valdiglesias, 2016). For instance, study results from (Lee et al. 2010) shows significant increased risk of physical symptoms such as headache, nausea, dizziness, whole body fatigue, sore throat, coughing, runny nose, skin flare, and sore eye were obtained. Laffon et al. (2016) asserts that research studies have also generally reported a higher score of prevalence of depression, anxiety disorder, psychological street as well as posttraumatic street disorder within oil-exposed environments.

Research evidence from the oil spills in Equator reports that; the same oil spilled water is unfortunately been used as a major source for drinking, cooking and bathing (Gay et al. 2010); as such they reported of experiencing skin rashes while children are reported to show horrible rashes and sores on their skin from the oil contaminated water (McGovern, 2008).

Research evidence from Kuwait asserts that the burning of crude oil wells released toxic chemical into the atmosphere (Gay, 2010). The burning of oil wells according to Husain (1998) "produced large amounts of toxic gases including sulphur dioxide (SO_2), carbon monoxide (CO), hydrogen sulphide (H_2S), carbon dioxide (CO_2), along with the oxides of nitrogen ($NO(x)$) as well as particulates containing partially burned hydrocarbons and metals". These emissions resulted in significant changes in meteorological patterns and ecosystems as well as adverse effects on human health resulting from the smoke and air pollution (Gay, 2010).

In the Niger Delta region of Nigeria, the risk of oil spills is reported to have led to skin infections, diarrhoea, bronchitis, eye infection and asthma as the most common health implications (Michael, 2018). Another study by (Roland & Anna 2017) reports that oil spill doubles the risk of baby death in Nigeria – especially for mothers who are living close to an oil spill site. The study records that this happens as a result of the inhalation of harmful hydrocarbons by the mother that affects the baby. People living close to oil

production sites are at a greater risk of air pollution and developing skin cancer as well (Atubi, 2015).

2.3 Oil Spill Response Methods, Equipment and Resources

Successful oil spill clean-up operation is dependent on the type and quantity of oil spill response equipment and should be done efficiently using different response methods and appropriate equipment (Ventikos, et al. 2004). This section reviewed two categories of oil spill response methods and equipment's which are: the conventional and alternative/advanced clean-up methods.

2.3.1 The Conventional Cleanup Methods

Refers to those commonly used techniques at the initial response phase and consist of the following three response methods as well the type of equipment used:

Mechanical clean-up methods: are used for the containment and recovery of oil on sea surfaces. This method is capital intensive, requiring logistical support and it success is dependent on the type of oil spilled, weather and the state of the sea. The following mechanical clean-up approaches are mostly used:

- Booms – according to the (ITOPF, 2014) are devices designed to perform any of the following functions:
  - Oil containment and concentration: making a surrounding around the floating oil to prevent it spread thereby increasing it thickness to ensure easy recovery.
  - Deflection: here the oil is redirected to suitable collection point offshore for removal by vacuum trucks, pumps any other recovery methods.
  - Protection: here the oil spill is diverted away from economic and biological sensitive sites to protect Mari-culture and natural reserves.

There are four categories of oil containment booms. The first is curtain booms - used in offshore situations with a good wave response; the second is fence booms - used in high-current areas, the third is shore sealing booms – used as a barrier in inter-tidal zones and fourth is fire-resistant booms – used together with in situ burning techniques.

- Skimmers: the (ITOPF, 2014) describes skimmers as tools designed to recover oil instead of water. They are of different designs used for different purposes as in sea, sheltered waters or onshore. Different mechanisms are used with skimmers such as; "oleophilic systems relying on adhesion of oil to a moving surface, suction systems, weir systems relying on gravity, and systems that physically use scoops and belts or grabs to lift oil" (ITOPF, 2014).

Chemical methods are used to primarily achieve a change in the physical and chemical properties of oil and include the following methods:

- Dispersants: are used during the occurrence of large oil spills to reduce the interfacial tension between oil and water. The three types of dispersants are: conventional dispersants; concentrated undiluted dispersants and concentrated diluted dispersants. Dispersant solvent are used for the performing of two major functions, which are; to act as a "thinner", i.e. reducing the viscosity of the surfactant and; to promote the penetration of the surfactant (ITOPF, 2014).
- Other chemicals: such as; emulsion breakers - used to break water to oil mixtures; gelling agents; bioremediation chemicals; burning agents; neutralizing agents; sinking agents and so on.

Natural degradation: this approach is referred to the "do-nothing approach" - the only action that is taken is monitoring of the oil spill movement.

2.3.2 Alternative/Advance Cleanup Methods

These are considered as alternatives to be used in special situations.

Bioremediation: According to (Asdpour, Sapari, Tuan, Jusoh, Riahi, & Uka, 2013) is method breaks down complex compounds into smaller compounds. That is, micro-organisms such as bacteria, yeasts, and fungi are important in the process of achieving bioremediation. This method is most effective within 45 days of initial oil concentration (Zahed et al. 2010).

In situ burning: this method is mostly adopted for large spills and it is recommended to be carried out as early as possible to avoid the occurrence of evaporation (Al-Majed et al. 2012), which has the tendency to produce large amount of smoke in a rainy weather.

2.3.3 Essential Elements to an Oil Spill Preparedness

According to (Muthike, 2018) in an "assessment of Kenya's capacity to effectively prepare for and respond to oil spill incidents" identified the briefly discussed elements as key to a successful oil spill preparedness:

Regulations on oil spill preparedness and response: citing the (IMO, 2010) Muthike explained that the 1990 OPRC Convention adopted by IMO stipulates that countries should establish legislation and regulation to support oil spill preparedness, the policies should provide for oil pollution emergency plans, oil spill reporting procedures, as well as regional and national cooperation.

Incident Management System: the (IMO, 2010) states an effective management system should ensure active command and control to response incidents, it should incorporate other organizations to achieve efficient response.

Oil spill response contingency plan: that provides for scenario matching with response strategy that provides for external assistance through a tiered approach.

Oil spill response community: the central argument here is for the involvement and active participation of community inhabitants in decision making, policies attainment on oil response techniques (IPIECA-IOGP, 2015).

Oil spill risk assessment: is done to assess the risk, identify possible risk scenarios and appropriate response strategies that should be adopted.

Oil spill response training: training is critical to successful oil spill response, without proper training there exist a higher health, social, environmental and economic risk on affected communities and clean-up personnel. Therefore, training activities should incorporate simulations to aid in identifying possible challenges and adopting timely response strategies (IMO, 2010).

Tiered oil spill response approach: (Muthike, 2018) states that "this approach calls for the integration of oil industries, port and shipping, stakeholders and government agencies for cooperation and partnership", using the following tiers (IPIECA-IOGP, 2015):

Tier 1 provides resources and respond to an oil spills within the area of operation

Tier 2 requires more resources to respond effectively to an oil spill

Tier 3 incorporates the efforts of 1 and 2 and also requests for international resource assistance.

Sensitivity mapping: are essential to knowing affected environmental areas by oil spill and taking appropriate actions to respond to specific oil spills thereby preventing further damage through the marine pollution alert systems of oil spill incidents (IMO, 2010).

2.4 Challenges in Implementing the OPRC

The Oil Pollution Preparedness, Response and Co-operation Convention (OPRC), was established with purpose of providing rules, procedures, guidelines and framework for international co-operation in combating oil spill incidents and it threats to marine environment through pollution. It was developed to promote technical co-operation among states on combating oil spills, promoting research and development as well as promoting of bilateral and multilateral co-operation in oil spill preparedness and response across the globe. Member states are obliged to setup effective measures that can control and respond oil pollution at national and international levels. Achieving this, requires countries to develop their own respective oil pollution emergency response plan that is in consolidation with IMO's standard requirements.

The OPRC is considered important in improving opportunities of mutual co-operation and offering of assistance across countries and regions, especially in locations there exist no regional, bilateral or multilateral conventions (De Oliveira, 1990). It is also important in creating the possibility of prompt and effective steps in responding and preventing the effects that can result from oil pollution through appropriate equipment and training for personnel. It also guarantees the protection of the marine environment from oil spills

through planning, reporting, sharing of technology and promoting national, regional and global cooperation (Ite, et al. 2016).

However, the OPRC has its own effected requirements that member states must comply with, these requirements are obstacles for it successful implementation in developing countries who lack the necessary structures for it realization (De Oliveira, 1990). For instance, the development of national contingency plan requires the availability of expertise and competent who are not readily available within countries and bring them from developed countries is expensive. The cost of implementation of these contingency plans also high considering the poverty status of most developing countries who are struggling with meeting the nations' need for food, shelter, education, healthcare services and so on.

Another, implementation challenge of the OPRC relates to the unique differences across continents and countries such as; extreme heat and cold climate conditions; landscape variations, unique shore types, islands, tundra coasts, unique oceanographic, seasonal shoreline and so (IMO, 2016). Furthermore, within countries, the responsible authorities such as; port authorities, maritime authorities, coastguard, and environmental agency and so on sometimes fail to keep-up to their responsibility (IMO, 2016).

More specially, the following challenges were identified as common in implementing environmental policies according to (Ite, et al. 2016 citing Jones, 2003).

 i. The lack of political will to implement national strategies.
 ii. Low/poor participation of the public in governance policies with no unclear responsibilities.
 iii. Poor prioritization of the environmental issues and lack of advance development of effective environmental law and policies prior to negotiations.
 iv. Lack of proper integration of environmental laws into national policies.
 v. Limited technological and financial expertise and resources coupled with economic growth challenges.
 vi. Limited local professionals with scientific knowledge in environmental laws and other related disciplines.

vii. Excess bureaucracy in government, high level of corruption and poor environmental governance Fragmented national institutional structures and lack of regional body to oversee implementation of existing legislations.

viii. Poor representation of developing countries during multilateral negotiations and development.

ix. Weak enforcement of existing national and international environmental legislations.

x. Lack of responsibility for environmental damage (corporate and social responsibility).

In attempting to address the challenges associated with the implementation of the OPRC and it protocol (Taylor, Bjerkemo, & Taylor, 2010) recommended the following six steps:

1. Establish the legislative basis and necessary funding to implement the Convention and the Protocol that includes the IMO ship-source marine pollution compensation Conventions.

2. Create a national organizational structure that embraces appropriate government agencies and private sector participants.

3. Define the roles and responsibilities of each agency or entity involved in the National Plan.

4. Develop the national plan, build the capacity to respond and assess preparedness.

5. Foster regional and international relationships and agreements for mutual support and cooperation.

6. Develop and maintain a regular training and exercising program at local, national and regional levels

Considering the fact that Sierra Leone is not yet a major player in oil exploration and transportation, it is but necessary that these recommendations are taken seriously and necessary steps taken for their immediate implementation. As the country is already experiencing the negative effects of oil spill within it economic zones even though it is at a minimal level. That is all the more reason why actions should be taken now.

CHAPTER THREE - RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research framework adopted in the study to achieve the research objectives. It describes the research design, area of the study inclusive of the Maritime boundaries and coastal zones of Sierra Leone, study population, sample selection and data collection and analyses methods used as well as ethical issues deliberated in the study.

3.2. Research Design

This study adopted the descriptive survey type of research, were data was collected systematically at a certain point in time, analysed and presented to provide an understanding on the risk of oil spills in the exclusive economic zone of Sierra Leone.

The design was used because it examined the problem at hand thoroughly to define it, clarify it, and obtain pertinent information that can be of use to stakeholders involve in governance and especially those in the environmental and oil production sector of Sierra Leone. The methodology in question helped the researcher to review the link between oil spill risk in the exclusive economic zone of Sierra Leone and effective oil spill response preparedness.

The research adopted qualitative research design, because it describes a particular situation/problem rather than a sweeping statistical survey. Since the sample size for this study is small, the qualitative research design was adopted as the most appropriate method without any limitations to participants' responses as presented in data collected. With this approach, it is assumed that qualitative design provides more realistic responses than a purely statistical survey.

3.3 Study Area

Figure 1 Map of the Country of Study

Source: Google Map, 2019.

The Statistics Sierra Leone National Population and Housing Census (PHC) Survey (Statistics Sierra Leone, 2015) estimates the total population of Sierra Leone at 7,092,113; with 4,187,016 people living within the rural areas (59.0%) and 2,905,097 living within the urban areas (41.0%). Table 2 below presents a graphical representation of the population of Sierra Leone per district.

Table 2: Shows Population of Sierra Leone per District

Sierra Leone Population At District Level		
	District	**Population**
Eastern Region	Kailahun	526,379
	Kenema	609,891
	Kono	506,100
Northern Region	Bombali	606,544
	Kambia	345,474

	Koinadugu	409,372
	Port Loko	615,376
	Tonkolili	531,435
Southern Region		
	Bo	575,478
	Bonthe	200,781
	Moyamba	318,588
	Pujehun	346,461
Western Area	Western Area Rural	444,270
	Western Area Urban	1,055,964

Source: Statistics Sierra Leone, 2015.

3.3.1   Description of the Exclusive Economic Zone of Sierra Leone

In order to understand the geographical scope and importance of the study, it is necessary to elaborate on the unique nature of the EEZ and continental shelf of Sierra Leone. According to the **Invalid source specified.**:

> The Exclusive Economic Zone (EEZ) of Sierra Leone covers about 160,000 km2 (Figure 2 and Table 2). The continental shelf of the coast of Sierra Leone is about 100km wide in the north and tapers to about 13km in the south towards Liberia. The total continental shelf area covers about 30,000 km2 and it is perennially enriched by nutrients from the river networks, rendering the coastal environment a unique ecosystem, which serves not only as an important habitat for assemblages of marine organisms but also as a feeding and breeding ground for most economically targeted species.

> The Sierra Leone continental shelf can be divided into four zones: the inner shelf, the middle shelf, the outer shelf and the shelf edge. The shelf is characterized by relatively plain surfaces inclined at angles of a few minutes and with an average width of about 62km. The outer shelf limit lies at an average depth of 160m. Each shelf zone is characterized by different angles of inclination of the bottom and they lie parallel to the coast in extensive strips. The inner shelf zone could be

traced up to depths of about 20–30 meter, and is the zone of active wave activity. The geomorphology of this zone is closely related to that of the adjacent coast.

Major relief features include the coastal valleys of the Futa-Jallon highlands composed mainly of Palaeozoic sands. The coastal valleys are covered with weathered and erosion products of the Futa-Jallon highlands. High temperature and moisture enhance intensive chemical weathering. The weathered material finds its way into rivers and is carried to the coast, where it is transported alongshore. The relief of the rivers catchments enables the movement of large quantities of terrigenous material (mainly quartz) into the ocean with waters of the surface flow. Other sediment sources including biogenic sediment sources are of secondary importance to the region. The chemical composition of the sedimentary material has a wide range and various types can be identified.

The middle shelf zone lies at depths between 20–30 meter and 60–70 meter and is usually the widest part of the shelf with a comparatively smooth surface. The bottom slopes at an angle of some few minutes and at some locations it is less than a minute. The outer shelf lies below 60–70-meter depth and is smaller in width with greater angles of inclination of the bottom. In some parts bed rock is common. This part of the shelf is commonly incised by the heads of canyons.

The northern portion of the Sierra Leone continental shelf is fairly wide about 50–100 km on average. Its central part is incised by laterally sloping valleys which have connections with present day river valleys and may well be their submarine continuation. Prominent features on that part of the shelf include the submarine deeps of Konakridee and Yelliboya. The southern portion of the shelf is narrow being part of the Liberian shield and is about 45 km wide. The bottom slope is steeper than in other parts of the shelf, probably due to its narrowness. Amongst the prominent geomorphic features in that part of the shelf are the St. Ann shoals and Galina's delta. The St. Ann shoals trend northwest from Sherbro Island, reaching the outer shelf at the southern edge of the area and is roughly 30km wide. It rises to depths of 5-14 meter and the surface is marked by several linear

sand ridges oriented northeast southwest which are 3-5-meter-wide and up to 7 meter high. (P.13).

Table 3: Shows Statistics of Sierra Leone's EEZ

Basic statistics of Sierra Leone's EEZ *(www.searoundus.org)*	
EEZ area	159,300 km²
Shelf area	26,611 km²
Inshore Fishing Area	18,301 km²
Tropical Coral Reefs	0.032 % of world
Seamounts	0 % of world
Primary production	651.22 mgC/m²/day
EEZ declaration year	1971

Source:**Invalid source specified.**

Figure 2. Maritime boundaries of Sierra Leone (GRID-Arendal)
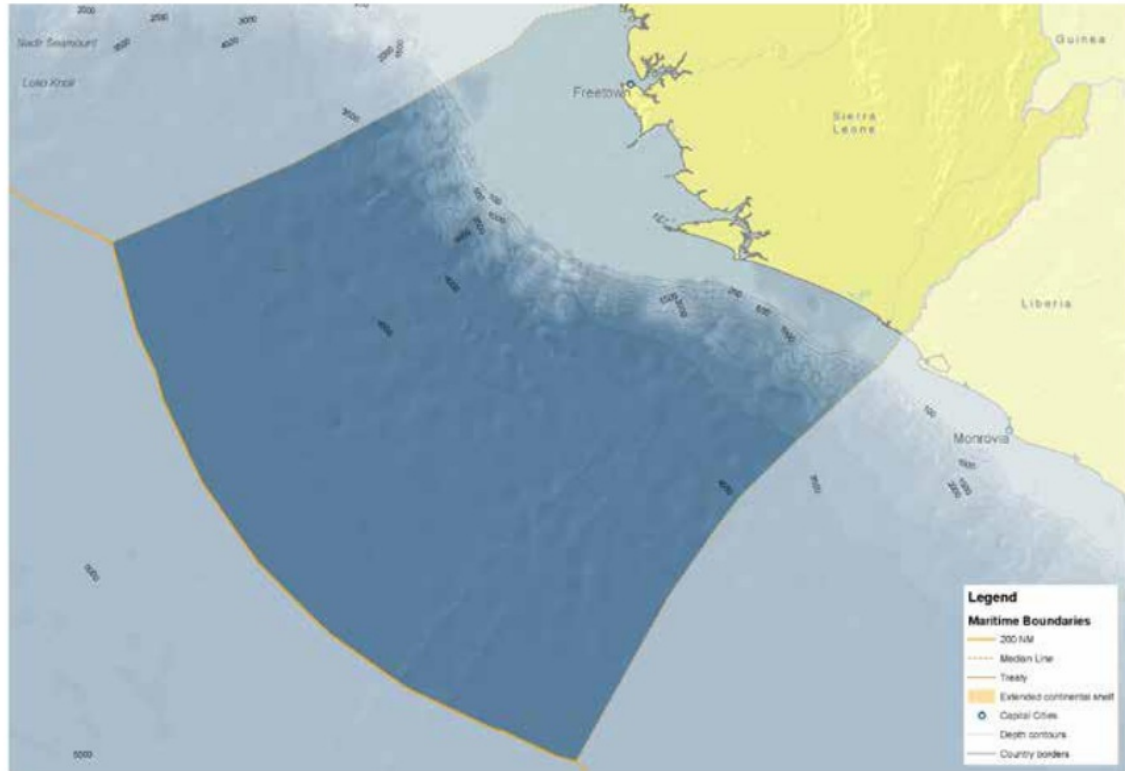
Source:**Invalid source specified.**.

3.3.3 Sierra Leone's Coastal Zone Biodiversity Effects

Artisanal fishing

Seafood is crucial to food safety in Sierra Leone and an oil spill can pose major dangers in this respect and because of the importance of certain sectors. Artisanal fishing activities according to the (Environmental Protection Agency, 2015) report, has little effect on marine environment despite it significant contribution to economic development in the country. According to Neiland, et al, 2016, it was confirmed that Sierra Leone 's fish resources have an approximate capitalized economic value of USD 735 million and may theoretically make an increased contribution to GDP under acceptable conditions

above the current estimated level of 10%. It is estimated that the fisheries sector provides more than 500,000 people with jobs, primarily in coastal communities (Neiland, et al, 2016). Sierra Leone's natural marine resource is a major source of livelihood for both commercial and artisanal fishing. Providing employment opportunities for thousands of local nationals and foreign exchange for other countries, this in itself has though good for the country but leads to increased pressure on the available fishery resources which needs to be managed efficiently. This is a challenge the country is grappling with in respect to monitoring and enforcement of agreements entered into with foreign partners and illegal invaders.

Tourism and Recreation

Sierra Leone is endowed with natural and beautiful sandy beaches, coastal regions and marine ecosystems that are of immense value for tourism and recreational purposes. Despite these opportunities, the country's tourism sector activities are still low (Environmental Protection Agency, 2015). This could be as a result of the limited hotel facilities and infrastructures in Freetown and across the country to attract tourist. However, the conscious efforts are being made to stimulate rapid development of the tourism sector and improvements are being seen slowly. The growth of tourism has the tendency to significantly affect the flora and fauna; causes pollution, land erosion, natural resources depletion and so on (Environmental Protection Agency Sierra Leone, 2017)

Agricultural Activities

Sierra Leone's agricultural practices over the centuries continues to be what is referred to as the slash-and-burn cultivation**Invalid source specified.**. This approach is assumed to be one of the major reasons for the destruction the forest ecosystem of the country. The report went on to explain that, the destruction of natural habitat by agricultural related activities is widespread across the country resulting in habitat non-availability, lack of distribution of some species affected, restricted flow of gene, evolution and speciation. Another concern relates to agricultural practices of burning lands as part of land preparation for planting, which is increasing carbon-dioxide emission into the atmosphere thus contributing to climate change effects.

Other concerns raised by the report, relates to the destruction of mangroves which are used for wood, charcoal and construction. These further results in habitat destruction and biodiversity loss. Also the chemicals used by companies such as; Biopalm Oil Star, Socfin Oil palm, ADDAX Bioenergy Company amongst others are also dangerous to the aquatic and marine environment.

3.4 Study Population

3.4.1 The Coastal Population of the Country of Study

According to (Environmental Protection Agency, 2015) the total population along the coastal regions of Sierra Leone is estimated approximately to be 1,347,000 persons. This population in not evenly distributed. Along the Scarcies River and Lungi regions in the North, the population is estimated around 80,000, along the Peninsula regions of Freetown is around 1,250,000 and in Shenge, in the Southern region the population is about 9,000 while; in Bonthe Sherbro it is about 8,000 inhabitants. These population is estimated to growth at an annual rate of about 2.5%; which means government and its stakeholder institutions should take urgent and necessary policy action and implementation to promote the coastal environment and its resources in pursuit of national development in the country.

3.4.2 The Population of the Study Area

Population is the total members of a defined class of people, objects, places or events selected because they are relevant to one's research questions. Martins, (1996) stated that the population is the aggregate of elements from which the sample is drawn. Aaker & Day, (1998) concur, but add that it is important to determine the target population. In this study, the target population which is the entire set of units for which the research data would be used to make inferences or generalization was Sierra Leonean citizens respondents from the following institutions in Sierra Leone; the Environmental Protection Agency (EPA), the Sierra Leone Maritime Administration (SLMA), the Ministry of Fisheries, the Petroleum Directorate, Sierra Leone Ports Authority (SLPA), Sierra Leone Shipping Agency (SLSA), Maersk Line, Non-Governmental Organizations (NGOs),

Local authority such Paramount Chief, Civil Society the Metrological Agency and Office of National Security (ONS) using the purposive sampling technique.

3.4.1 Sample Size of the Study

Martins, (1996) stated that sampling involves defining the population, identifying the sample, selecting the sampling method and sample size. It is a selection of a group of people or events from a population to be able to find out true facts about the sample that will be true of the population. This became necessary as the entire population cannot be studied due to the size, inaccessibility, time and financial constraints. The study reached twelve (12) respondents from major stakeholders involved in environmental protection and oil exploration activities within the EEZ of Sierra Leone. A total of one respondent each was targeted from the following institutions: in Sierra Leone; the Environmental Protection Agency (EPA), the Sierra Leone Maritime Administration (SLMA), the Ministry of Fisheries, the Petroleum Directorate, Sierra Leone Ports Authority (SLPA), Sierra Leone Shipping Agency (SLSA), Maersk Line, Non-Governmental Organizations (NGOs), Local authority such Paramount Chief, Civil Society the Metrological Agency and Office of National Security (ONS).

3.4.2 Sampling procedure

A sample is a small group of research participants from whom data is to be obtained. Sampling is a procedure, process or technique of choosing a sub-group from a population to participate in the study. The sample procedure shows the method used to obtain the sample. The researcher used the purposive sampling technique. This was used since the targeted population for the study is not randomly distributed in the research area. As such, respondent stakeholder institutions that were purposefully selected demonstrated most of the characteristics of the target population under study and have excellent knowledge as well as practical experience in the area of study. All the total sampling of 12 respondents was selected randomly where in every top-executive within the organization has an equal chance of being selected.

3.5 Data Sources

Data sources for this study comprised of primary and secondary sources as briefly discussed below.

3.5.1 Secondary Data

The secondary data used in this study were extracted in already documented materials such as from websites, blogs, newsletters, reports, records, books, and journals, published and unpublished documents that were found useful for the study. The data obtained from these sources were scrutinized for reliability, validity, adequacy and suitability in answering research questions. Achieving this, the researcher used a wide range of multiple independent and credible sources of data.

3.5.2 Primary Data

Primary data can be defined as the fresh information gathered for the first time and happens to be original in character. Thus, according to the nature of the study structured questionnaires interviews were used as the tool for collecting primary data used in the study. This enabled the researcher collect his own original data from targeted respondents. The data collected was qualitative.

3.5.2.1 Questionnaire

The use of questionnaires was adopted in this study and enabled the researcher to reach out to a selected number of respondents within a short time; give the respondents' adequate time to respond to the items, offer a sense of security (confidentiality) to the respondents and it is an objective method since no bias resulting from the personal characteristics.

In the questionnaire, the researcher used multiple choice questions with single answers, multiple-choice questions with multiple answers to capture respondent's background information. Open-ended questions were used to collect data on the risk of oil spills in the EEZ of Sierra Leone; risk classification methods in Sierra Leone, response equipment and supporting resources, implementation of the OPRC in Sierra Leone and general recommendations. This allows respondent's the opportunity to freely expression their thought, experience and expert knowledge in answering the research questions without

restrictions or any limitations in their thoughts. The questionnaires were completed by respondents. The final questionnaire interview questions for the study is provided in APPENDIX 1.

3.6 Methods of Data Analysis

Data collected was qualitative using a structured questionnaire interview question. The results were grouped and analysed using themes and sub-themes. A spreadsheet package (Microsoft Office Excel 2013) was utilized to investigate the information because it is generally easy to use and understand; good for organizing and analysing data; and can analyses a large volume of data.

3.7 Validity of the Research Instrument

Validity was used to determine whether research measured, what it intended to measure and to approximate the truthfulness of the results. The study ensured that valid questions were only asked.

3.8 Limitation of the Study

One major limitation is the lack of availability of relevant literature for the Sierra Leonean context to oil spill risk and preparedness, as limited empirical studies have been undertaken in Sierra Leone. As a result of the limited information available, the research literature tends to focus mostly on literatures from oil producing countries in developed economy and in Nigeria, South Africa and Kenya within the African continent. Data collection from targeted respondents within government institutions posed serious challenges resulting from bureaucratic processes and procedures to releasing information. Also, the researcher was constrained with finance as the researcher had to rely on limited resources available to meet the cost of the study.

3.9 Ethical Consideration

The researcher informed respondents that participation in the study is voluntary and data collected will be treated with utmost confidentiality. Information disclosed by respondents was not made known to other respondent. To ensure this, personal or

demographic data were left in the work that is; names and addresses were made anonymous.

All participants were informed of the objectives of the research together with the implications attached to participating in the study. Also, explained to participants, was their right to respond to questions willingly and not under pressure to do so.

CHAPTER FOUR – RESEARCH FINDINGS, ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter presents data findings and analysis of the research results and discussions of results collected through questionnaires administered to key institutions involved in oil spill and it control in Sierra Leone. The chapter further compares and draws assumptions and conclusions from the literatures reviewed and the empirical research investigation using the research objective questions of the study as stated below:

1. To examine the risk posed by potential oil spills in the Exclusive Economic Zone of Sierra Leone
2. To develop a risk classification method for easier risk identification
3. To make recommendations to ensure the availability of effective response equipment and supporting resources
4. To assess the difficulties and obstacles of effective implementation of the OPRC in Sierra Leone

4.2 Result from the Empirical Investigation

Figure 2 Report on the Gender of respondents

Gender of respondents

42% 58%
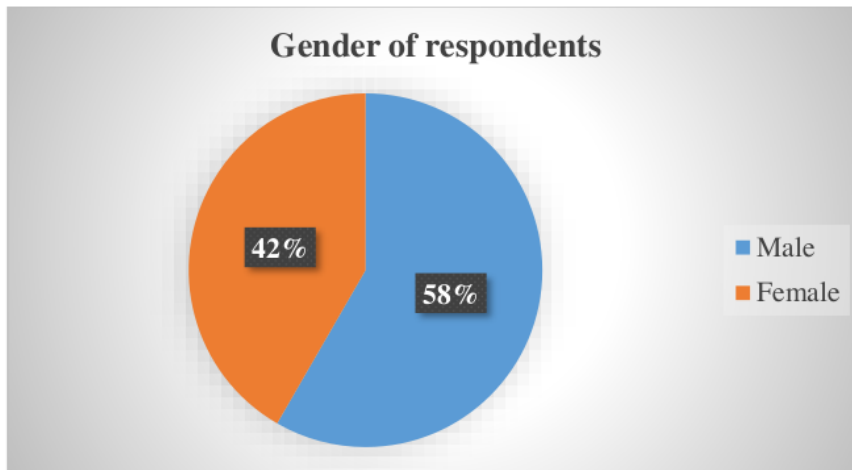
Male
Female

Source: *Field data, 2020*

As indicated in the figure above, 58% of respondents reached are male and 42% are female. This gender breakdown is fairly typical of those involved in oil spill response.

Figure 3 Report on the Age category of respondents

Age category of respondent

Age category	Percentage
50 & above	17%
45-50	17%
40-45	33%
35-40	25%
30-35	8%
25-30	0%
20-25	0%
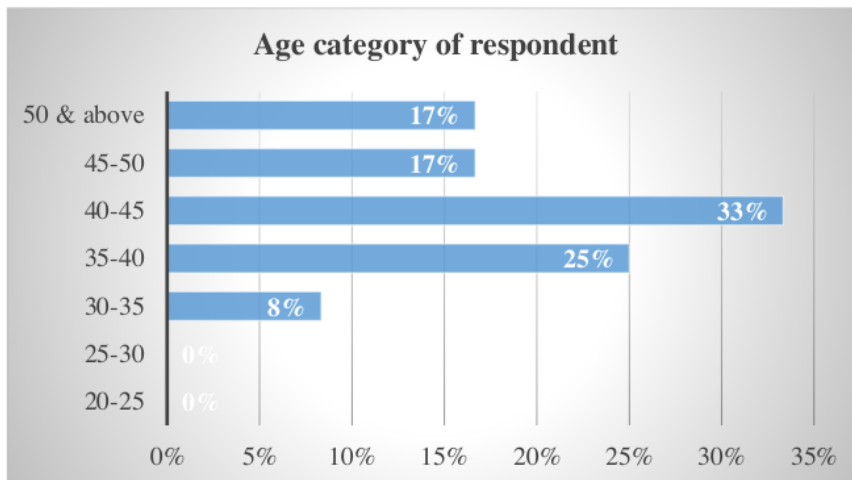
Source: *Field data, 2020*

Findings on the age category of respondents reveal that 33% are between the ages of 40-45 years and 25% between the ages of 35-40 years, while 17% are between the ages of

45-50 years and 50 years and above. Again this age breakdown is fairly typical of those involved in oil spill response.

Figure 4 Report on the highest education level of respondents
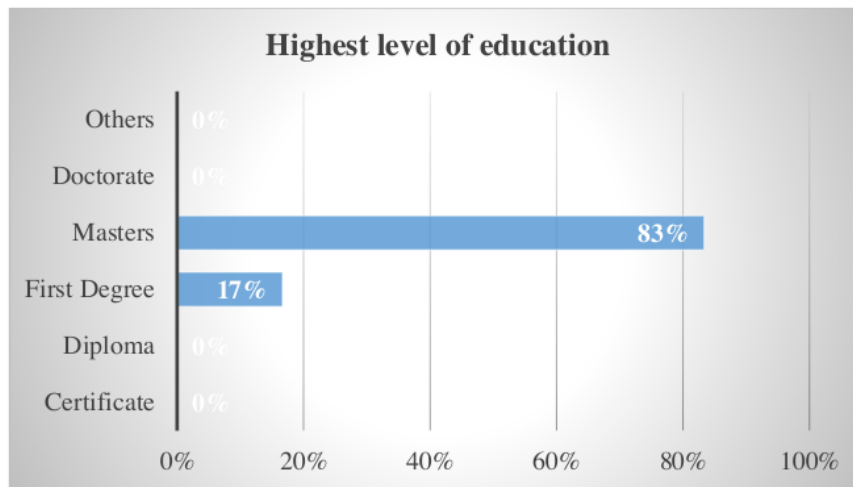
Source: *Field data, 2020*

On the level of education, 83% of respondents reported holding a Master's degree as their highest level of education and 17% are holders of a first degree. The high level of education of respondents contributes significantly to the quality, accuracy and reliability of the research findings. As the targeted respondents are people with a good level of understanding on the research subject and are knowledgeable on the scope of oil risk in Sierra Leone. This is also indicative of the technical and demanding nature of the expertise required for oil spill response.

Figure 5 Report on the Employment status of respondents
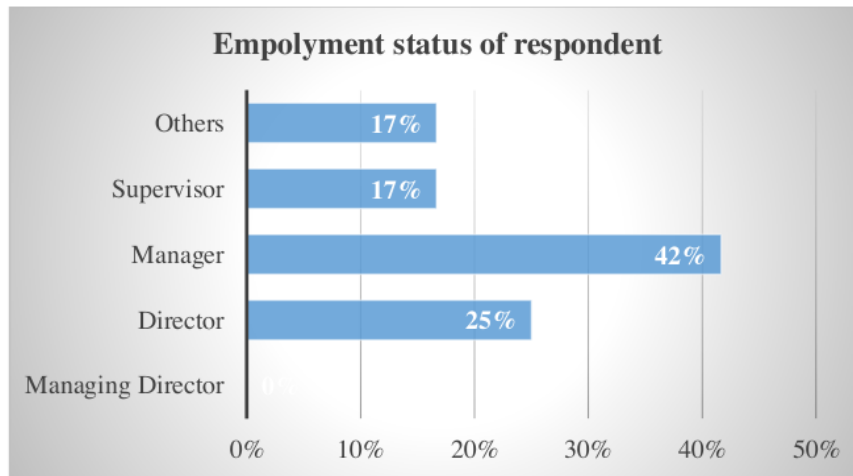
Source: *Field data, 2020*

42% of respondents reports they are Managers in their organization, 25% are directors and 17% supervisors and holders of other positions in their organization. The Managers and Directors of the targeted respondents' institutions are the ones who are mostly involved in operational activities and implementation of organisations programmes. This therefore; means the researcher collected data from the professionals who have access to organisational data and are a part of the decision making structures of their respective organisations.

Figure 6 Report on the availability of Oil spill preparedness response plan
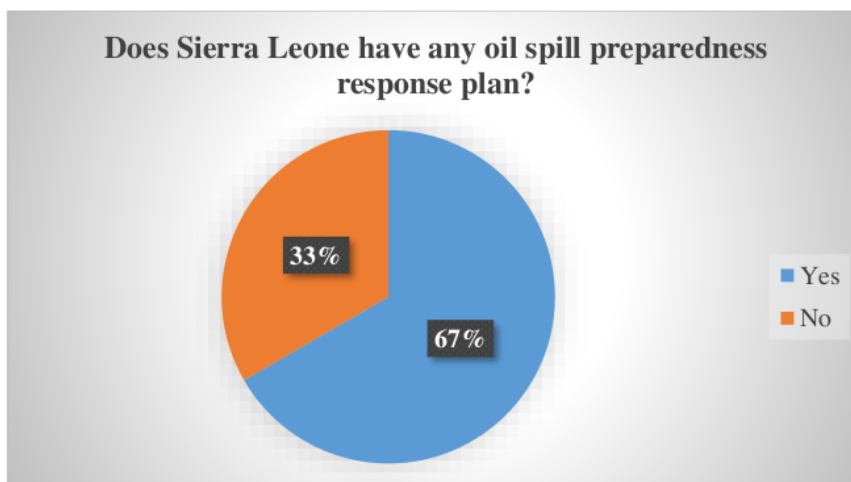
Source: *Field data, 2020*

With regards the availability of any oil spill preparedness response plan in Sierra Leone, the findings are somewhat surprising in so far that 67% of respondents reported in the affirmative while 33% are of the view that the country does not have any oil spill response plan. This variation in response to the availability of response plan can be ascribed to the fact that Sierra Leone has not recorded any major oil spill and therefore the existence of an oil spill response plan might not be visible to many even though it exist. As will be seen later, this findings raises concerns about the general awareness of the importance of oil spill response, as seen elsewhere such as the recent oil spill in Mauritius.

Table 4: Report on Oil spill exercise carried out in Sierra Leone

Has the country carried out any oil spill exercise within the last 6 months, 1 year, or 3 years?	6 Month	1 Year	3 Year
Yes	0%	0%	33%
No	100%	100%	67%
Total %	100%	100%	100%

Source: *Field data, 2020*

Data from the table above, reveals that there has not been any oil spill preparedness exercise carried out in the country for the last six (6) months and the last one (1) year respectively as reported by 100% of respondents. However, 33% of respondents report an oil spill preparedness exercise carried out within the last three (3) years while 67% report in the negative. This data further supports the findings presented with regards the availability of oil spill preparedness plan in Sierra Leone, as the country has only carried an oil spill exercise within last three years that is not well done about as reported by 33% of respondents compared to 67% who are not aware about such exercise. This is also relevant in light of the consequences of oil spill as seen in Mauritius.

Figure 7: Findings of last Oil spill exercise in Sierra Leone
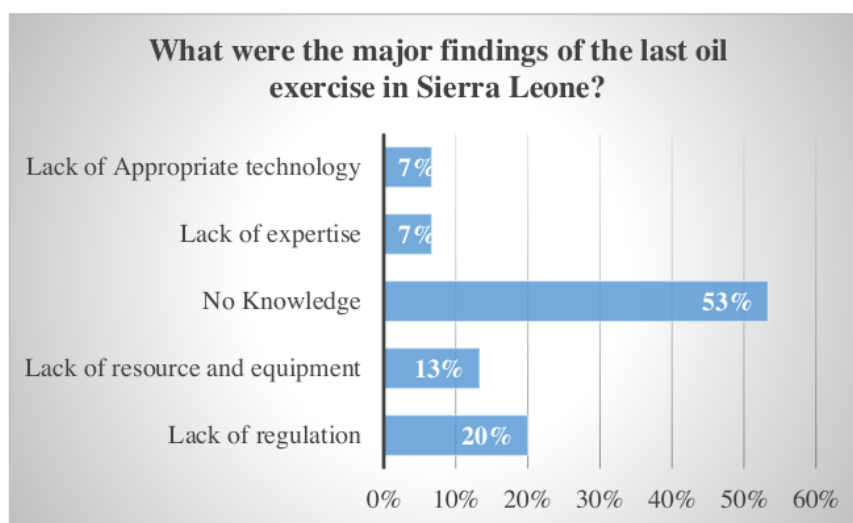
Source: *Field data, 2020*

Another surprising finding is that 53% of respondents report not having any knowledge on the major findings of the country's last oil spill preparedness exercise carried out within the last three years. However, 20% report the lack of regulation, 13% say the lack of resource and equipment and 7% reported the lack of expertise and lack of appropriate technology in the country as the major findings of the last oil spill exercise. Table 1 above, reports a 67% lack of knowledge about any oil spill exercise in the country, this

justifies the lack of knowledge on the findings of the exercise as reported by 53% of respondents followed by 20% lack of regulations on oil spill risk in the country.

Figure 8: The Type of Ships entering the EEZ of Sierra Leone

What type and number of ship that enters the EEZ of Sierra Leone?

Ship Type	Percentage
Bulk Carriers	11%
Oil Tankers	9%
Industrial Fish Carriers	20%
Research vessels	9%
Cargo Ships	20%
Petroleum Bunkering Vessel	20%
Container Vessel	11%
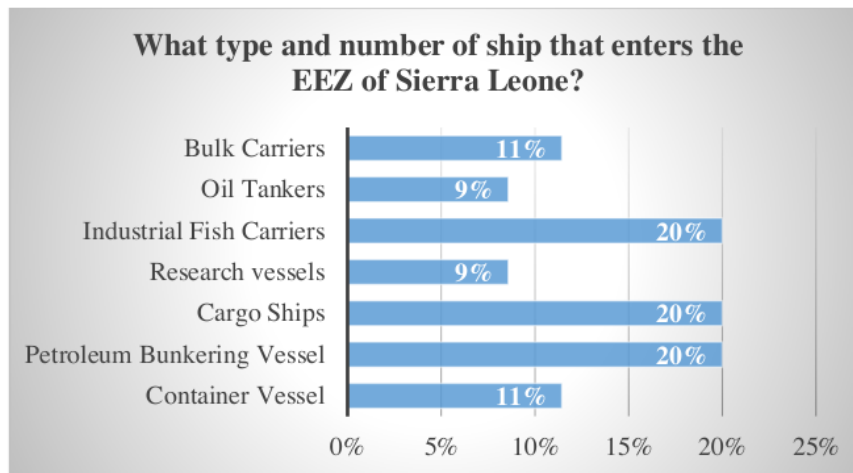
Source: *Field data, 2020*

Ships entering the Exclusive Economic Zone (EEZ) of Sierra Leone are reported as follows; 20% each for petroleum vessels, Cargo and fishing vessels, 11% Container, and Bulk vessels and 9% are reported to be Oil Tankers and research vessels. No data was reported on the number of ships entering the country's economic zone! This data shows the EEZ of Sierra Leone is congested more with petroleum, cargo and fishing vessels. This might be one of the major reasons why the country has not recorded any major oil spill. This said, the total combined number of petroleum and oil tankers amount to close to one-third of all shipping traffic entering the EEZ.

Figure 9: The effect of oil spill on the EEZ of Sierra Leone
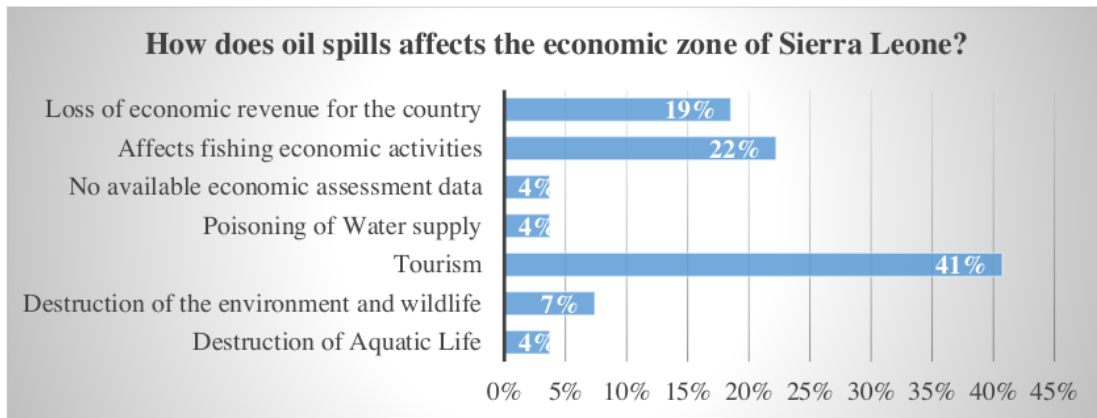
Source: *Field data, 2020*

Data collected from respondents showed that oil spill will affect the tourism sector most as reported by 41% of respondents; followed by 22% fishing activities and 19% resulting in significant loss in revenue for the country. The tourism and fishing industry is still an emerging market in Sierra Leone and has huge economic growth potentials. This sector has attracted thousands of Sierra Leoneans who make their daily living from tourism and fishing across the coastal environment of Sierra Leone. Thus, any major oil spill will result in huge economic effect on the economy of the country as described below by respondents;

"Sierra Leone for the last decade has not recorded any major oil spill incident. However, if any oil spill occurs in the EEZ of Sierra Leone, the effect will be disastrous and long lasting on the marine environment, because the country is ill-prepared in terms of logistics to handle such incident".

"It will affect government revenue mobilization due to a disruption in economic activities such as farming, fishing and tourism in the country thus affecting the country's economic growth and increasing poverty".

This finding supports those of (Saadoun, 2015), who asserts that communities whose economic activities involve exploiting resources from the sea are most affected in the event of an oil spill. Lee, (2011) holds the view that an oil spill will result in other issues

48

such as; loss in tourism revenues, increase in poverty, eroding of other emerging business opportunities and destruction of future economies that are endowed with ocean resources. Any major oil spill along the coastal regions of Sierra Leone will affect the country's economy significantly. Again as seen recently in Mauritius, the oil spill is reported by Bloomberg as the worst-ever ecological disaster possible for coastal tourism which was further exacerbated by the COVID-19 pandemic.

Figure 10: The Cost burden of oil spill in Sierra Leone
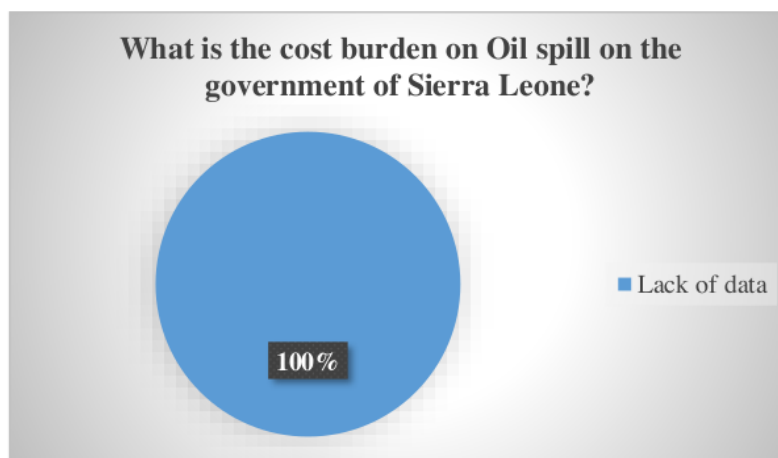
Source: *Field data, 2020*

On the cost burden of oil spill on the government of Sierra Leone; all of the respondents (i.e. 100%) reports that there is a lack of data to quantify this cost. This is lack of data is describe by a respondent as:

"the country has not recorded any major oil spill incident, therefore it is difficult to ascertain the cost burden of an oil spill specific to cleaning activities, response cost, and compensation and so on".

Considerable care needs to be exercised with this finding, in so far as the example of loss of the MV Wakashio, which led to a bunker of spill oil. There are some estimates that the total cost will be up to $18.7 million. Similarly, according to Cozier, (2020), mangrove

trees, beaches, shallow water reefs will be affected as they are hard to clean up and the associated habitat would also be affected.

Figure 11: The Types of Oil spill in Sierra Leone
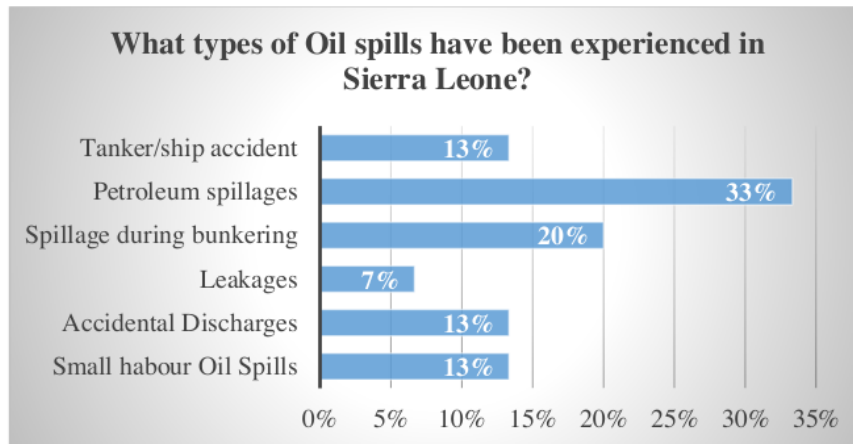
Source: *Field data, 2020*

Sierra Leone has not recorded major oil spills. As such the most common forms of oil spills reported during the period are as follows: 33% petroleum spillages, 20% spillages during bunkering, 13% accidental discharges small harbour oil spill and tanker/ship accident and 7% relates to leakages.

Figure 12: The effects of oil spill on social well-being of citizens

What are the effects of these different types of oil spills on the social well-being of citizens?

Category	Percentage
Loss of Income	4%
Poverty	13%
Air and water pollution	25%
Farmland destroyed	13%
Livelihood activities (i.e. fishing, tourism etc.)	42%
Lack of data	4%
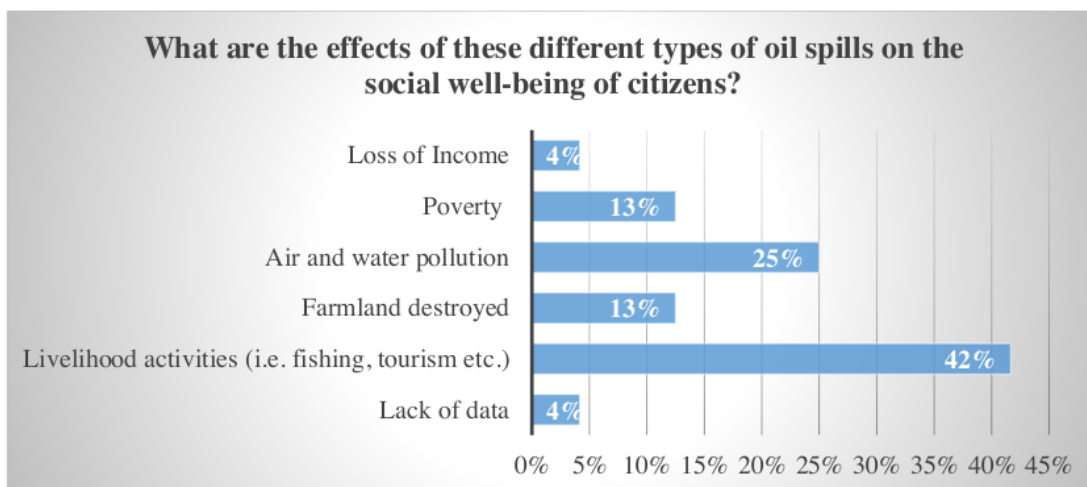
Source: *Field data, 2020*

Assessing the possible effect of oil spill on the social well-being of citizens; 42% respondents reports a disruption in their means of livelihood such as fishing and tourism; 25% are affected as a result of air and water pollution, 13% are affected due to the destruction of their farmland and increasing their level of poverty respectively!

Studies from Nigeria and Ghana (Chindo, 2011; Obeng, 2010) reveal that oil spills leads to loss of agricultural lands used for farming, affects biodiversity and deepens the already vulnerable poverty-stricken communities. Also (Richardson & Brugnone, 2018) oil spills affect water for domestic use and for tourism and recreational purposes which affects revenue mobilisation for affected beaches and water facilities. This position is also supported by findings from (ITOPF, 2011) that oil spills disrupts traditional economic activities from the tourism sector leading to significant loss in revenues for businesses and governments. Research findings (Ekoh, 2015) reports that water and air pollution by oil spills have resulted poor health conditions among humans, (Hou, Zhang, Wang, & Baccarelli, 2011 as cited by Sako, 2017) puts global death attributed to environmental pollution every year at 13 million deaths.

Considering, the poverty levels and weak health infrastructures in Sierra Leone, a major oil spill outbreak will be catastrophic; as the country is ill prepared to adequately respond

51

to such level of oil spill. Furthermore, there are other compounding factors at play including vulnerability to weather condition, inadequate infrastructure and a failing health system, and extreme poverty, high unemployment, and political fragility.

Figure 13: The effect of oil spill on marine environment and aquatic-life

What are the effects of these different categories of oil spills on marine environment, as well as aquatic-life?

- Environmental degradation: 14%
- Death of Aquatic-life: 19%
- Destroys Marine ecosystem: 57%
- Lack of data to ascertain threat: 5%
- No significant threat: 5%
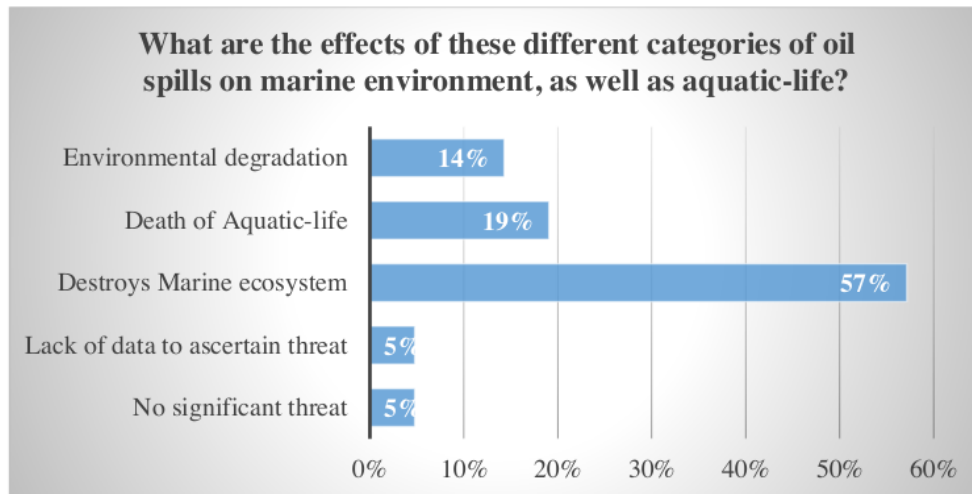
Source: *Field data, 2020*

Significantly, 57% of respondents report that the marine environment and aquatic-life are affected by oil spill through the destruction of the marine ecosystem; while 19% reported the death of aquatic-life and 14% were concern about environmental degradation issues. The effect of oil on the marine environment and aquatic-life is described by a respondent as leading to;

"Pollution of beaches, mangroves, the sea shore, etc. and will travel along the coastal with the tide. Water intake for plant cooling system will also be affected by oil spillages".

Results from (Ekwugha, 2014; Omorede, 2014; Ayuba, 2012; Yuemen & Adzigbli, 2018) reports on the following effects of oil spills on marine environment: environmental degradation, contamination of water bodies, destruction of aquatic life, forest, biodiversity loss, habitat destruction, mass mortality, impaired physiological functions such as reduced feeding, growth and development, respiration problems, loss of locomotion, balance and swimming amongst many others. A long-term consequence of

destroying the marine environment and aquatic-life through oil spill is its recovery which takes up to 15 years or more (Ayuba, 2012; Omorede, 2014). The spillage can cause severe adverse effects on the marine environment worldwide and the economic costs can be huge. For country such as Sierra Leone that is yet to be at high risk of such environmental destruction should prioritise environmental protection now.

Figure 14: Report on the availability of a regulatory framework on oil spill
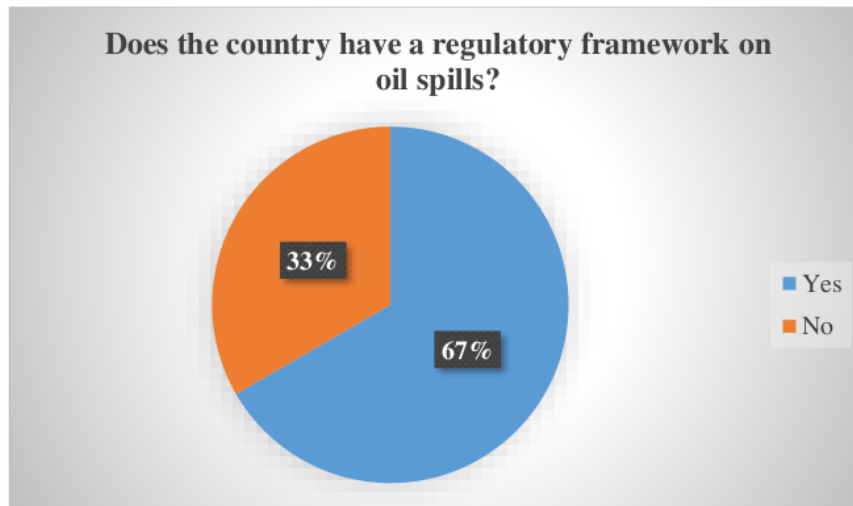
Source: *Field data, 2020*

The figure above report that 67% of respondents say Sierra Leone have a regulatory framework on oil spills while 33% say the country does not have any. This continues to expose the weaknesses of dealing with any possible oil spill risk in the country as the existence of regulatory frameworks are not well-known even among top executives and professionals. This is also compounded by the need for broad and strong professional support for dealing with spills in practice.

Figure 15: Report on the implementation of the oil spill regulatory framework
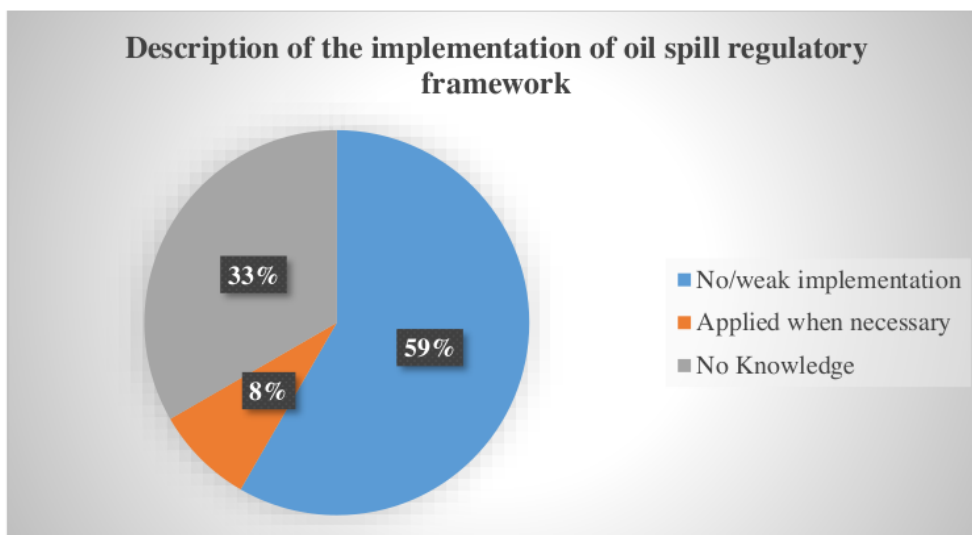
Source: *Field data, 2020*

On the implementation of the oil spill framework; 59% of respondents report that implementation is weak/no existence, 33% report having no knowledge about it implementation and 8% report it is implemented when necessary. This result is not surprising as oil spill response plan, oil spill exercise and oil spill regulatory frameworks are not well-known. This appalling situation with regards oil spill risk prevention and implementation in Sierra Leone is described below by respondent:

"Sierra Leone is party to the International Convention on Oil Pollution Preparedness, Response, and Co-operation (1990). The country is also party to the International Convention on Civil Liability for Oil Pollution Damage by Ships, 1992 (CLC) and the International Convention on the Establishment on of an International Fund for Compensation for Oil Pollution Damage, and many others. In fulfilment of the requirements of these agreements, Sierra Leone developed a regulatory framework on oil spill in 1994 known as the National Oil Spill Contingency Plan.

However, this was never implemented. Nonetheless, in 2006 the then Ministry of Transport and Communication instructed the Sierra Leone Maritime Administration to review the 1994 plan, and develop a Plan of Action for re-drafting the National Oil Spill

Contingency Plan, taking into account current and expected future development in the country`s maritime domain. Further, in 2013 the IMO and the International Petroleum Industry Environment Co-operation Association (IPIECA) to organize a national workshop on the National Oil Spill Contingency Plan.

However, the country has been unable to implement the National Oil Spill Contingency Plan because it lacks the capacity in terms of logistics to do so".

Figure 16: Report on resource availability to fight oil spill in Sierra Leone
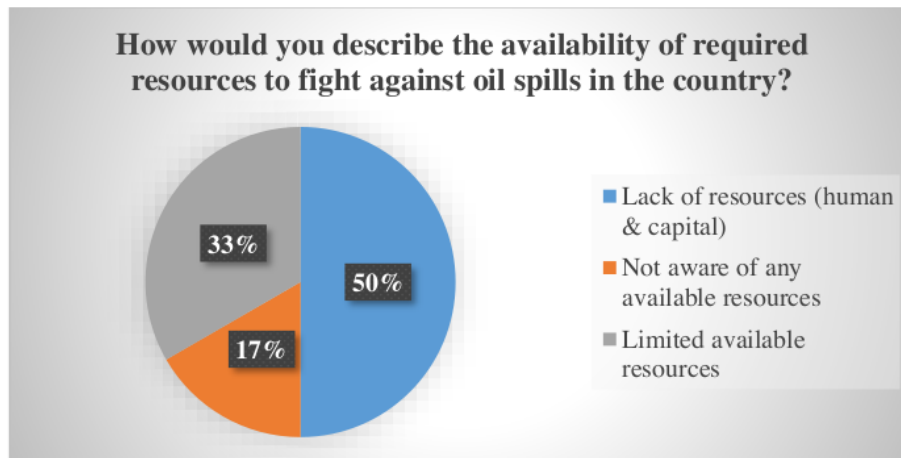
Source: *Field data, 2020*

The availability of resources to fight against oil spill in the country, 50% of respondents report that the country lacks the human and capital resource required; 33% reported the availability of limited resources while 17% report not being aware of any available resources in the country. The argument for the lack of resources (human & capital) is described by a respondent as follows:

"Sierra Leone has an EEZ with an area of about 155,700 Km^2. The country`s coastline is 210 nautical mile long (which is about 402 km). To police such an area against oil spill involves huge logistical requirements. The country only has a small navy which is ill-

resourced, and can monitor only about 15 percent of the EEZ. So, in the case of any oil spill incident the country will struggle to fight it".

"To my knowledge, I believe there are no adequate resources to handle oil spills at the moment. However, there is an emergency response centre in the region (i.e. Nigeria) and these are activated in time of tier 3 spills. This was established in the framework of the Abidjan Convention. But at national level, both human and equipment are not available for emergency response".

Thus, the country will experience significant losses in the event of an unexpected major oil spill within it coastal lines if urgent and needed actions are not taken as soon as possible!

Figure 17: Approaches to control oil spill
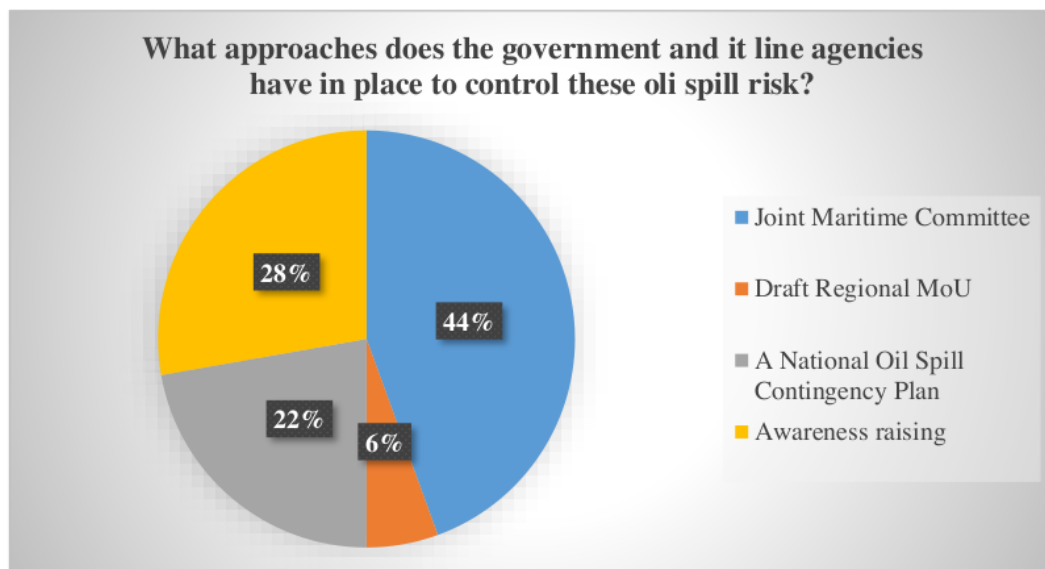
Source: *Field data, 2020*

The figure above reports that the government of Sierra Leone has adopted the following approaches to control the risk of oil spill such as; the establishment of a Joint Maritime Committee as reported by 44% of respondents; public awareness raising at 28%; the development of a National Oil Spill Contingency Plan at 22% and 6% reported for the

Draft regional MoU on oil spill. As a country, Sierra Leone has not done much in oil spill preparedness and response. Data collected from respondents show that:

"The government now has an oversight Joint Maritime Committee (JMC) that pools it assets logistics and manpower under a Public/private partnership. Also, regional MoUs are being drafted with neighbouring countries to respond to oil spills of an international nature"

However, reports from (IMO, 2010; IPIECA-IOGP, 2015) recommends the following as essential elements to an oil spill preparedness: regulations on oil spill preparedness and response; incident management system; oil spill response contingency plan; oil spill response community; oil spill risk assessment; oil spill response training; tiered oil spill response approach and sensitivity mapping. Of these recommendations, Sierra Leone is recorded to have an oil spill contingency plan which to many respondents should be updated! Again, this further reveal the weaknesses of the country's preparedness to respond to an event of oil spill.

Figure 18: Implementation challenges of OPRC in Sierra Leone

Challenges faced in the implementation of national laws in giving effect to the International Convention on Oil Spill Preparedness, Response and Cooperation in Sierra Leone?
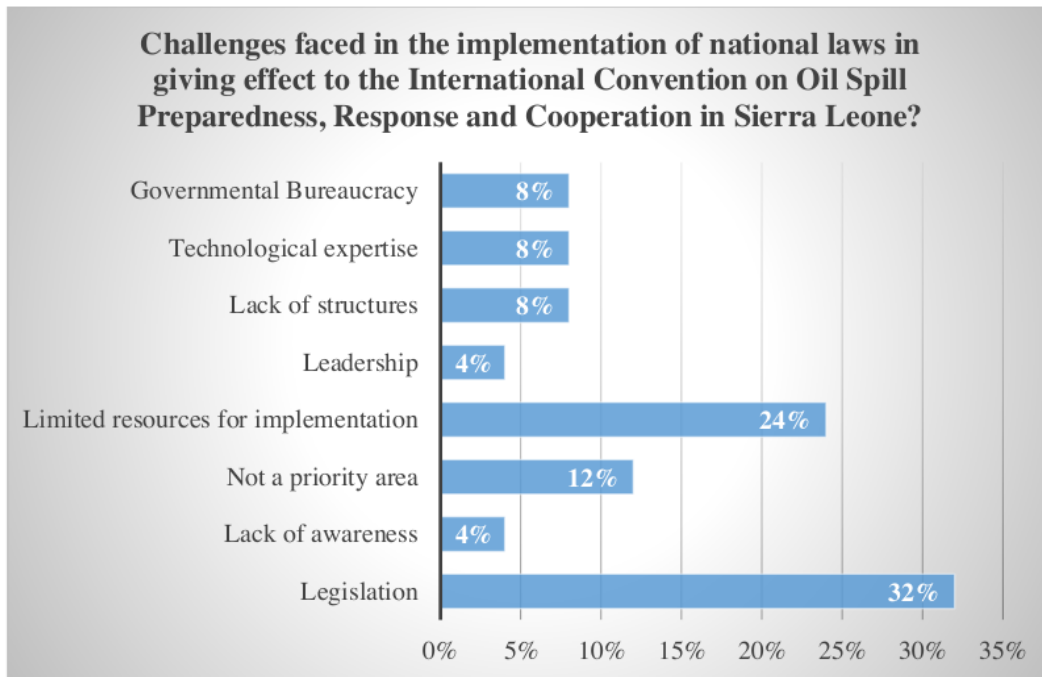
Source: *Field data, 2020*

The study reported the following undermentioned implementation challenges of the International Convention on Oil Spill Preparedness, Response and Cooperation (OPRC) in Sierra Leone.

- 32% of respondents reported legislation challenges as the top-most challenge followed by;
- 24% related to limited resources for implementation
- 12% report that oil spill issues have not been taken as a priority issue and;
- 8% was for technological expertise, government bureaucracy and the lack of appropriate structures for implementation respectively.

Figure 19: Challenges faced in Oil spill preparedness and response in Sierra Leone

Based on your expertise in Oil spill preparedness and response, please describe the challenge faced by Sierra Leone in Oil spill preparedness and response?

- Non-enforcement of national and international laws: 4%
- Lack of political-will: 8%
- Training opportunities: 4%
- Resource Allocation: 8%
- Leadership: 21%
- Not aware about any: 21%
- Lack of tools: 4%
- Lack of human capacity: 29%
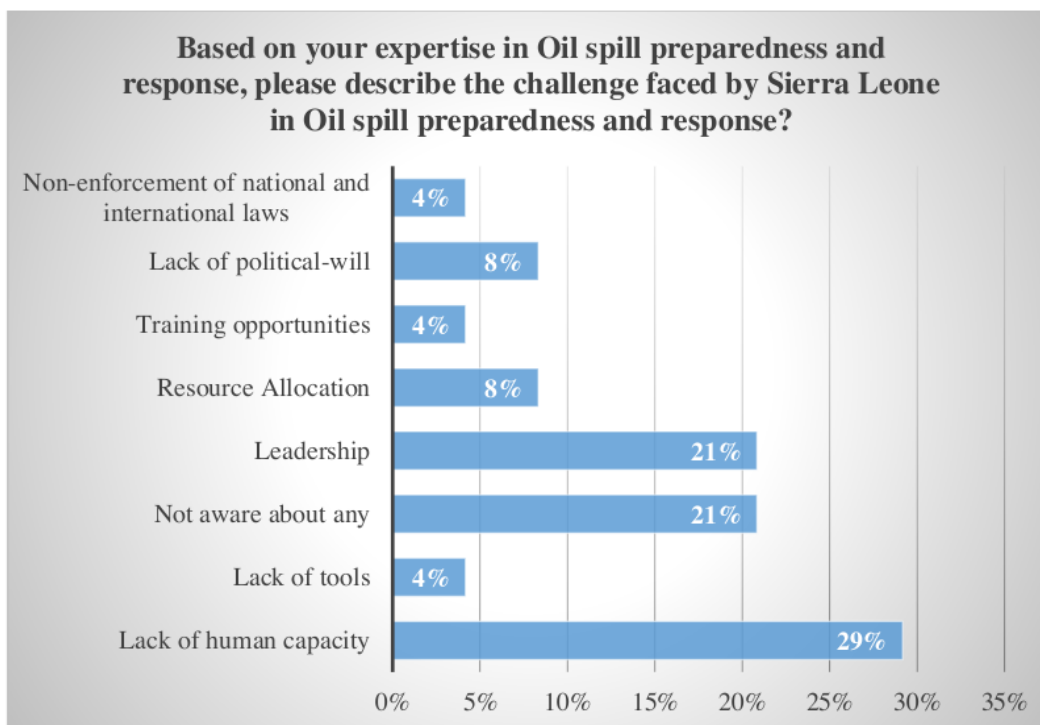
Source: *Field data, 2020*

On the challenges faced in oil spill preparedness and response in Sierra Leone; respondents reported the following:

- 29% reported the lack of human capacity in the country as the lead challenge,
- 21% are not aware of any challenge and leadership challenges respectively while;
- 8% reported resource allocation and the lack of political-will respectively.

The findings on the challenges associated with the implementation of the OPRC and oil spill preparedness and response plan are in line with the findings of (Ite, et al. 2016) who argues that developing nations such as Sierra Leone are faced with the challenge of integrating environmental management systems into existing national legislations and policies, the high level of poverty mean that governments prioritise spending in education, healthcare services, agriculture and so on and less so on environmental and oil spill risks even though they are also very important. Also, the high levels of government bureaucracy and corruption makes it even more challenging for the effective

implementation of environmental and oil associated legislation and policies in the country. This study has therefore; show that little or not much attention has been given to oil spill risk in the country, a reality that needs to be addressed.

CHAPTER FIVE – SUMMARYOF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

From the results and discussions presented in the previous chapter the researcher has arrived at the following conclusions:

A number of key regulatory and institutional elements are in place. Overall, there are positive and negative aspects to the approach followed by the country. That is to say, Sierra Leone has an existing oil spill regulatory framework, a National Oil Spill Contingency Plan and has also instituted a Joint Maritime Committee; all for the purpose of protecting the coastal and marine environment and with a view to responding to any event of oil spill risk. However, on the negative side, the study has not been able to record any accomplishments of these establishments, rather the findings from data collected reveals to a large extend limited level of knowledge about maritime activities among professionals in the field.

The study noted that a major weakness is the implementation of oil spill regulatory frameworks, which is almost non-existence in the country. There are limited or no available resources (capital and human) as well as tools and equipment for effective implementation. It was observed that; the government and stakeholders seem not to give much attention to oil spill preparedness and response plans as such progress in the sector is not measurable. There are a number of reasons and the principal one is that it can assumed that, because the country is not attracting huge tankers and oil transporting vessels therefore the risk of oil spill is not considered a priority!

However, similar to the oil recent spill from the Japanese-operated MV Wakashio in Mauritius in the event of any major oil spill in Sierra Leone, the country could experience

significant economic, social, health and environmental consequences especially when there exist no preparedness and response mechanism. The study concludes from the replies of the respondents that there are major reasons for this situation including the country to-date lacks the required leadership, political-will, infrastructure, tools and equipment's to handle a major oil spill response and clean-up exercise.

It is therefore an absolute imperative that the country takes urgent and necessary actions now that the risk of a major oil spill is minimal. Sierra Leone has the potential to attract huge investment potentials into oil exploration and processing as well as the risks posed by bunkering at sea in the EEZ thus it is best to lay the foundations for such opportunities are built now!

5.2 Recommendations

Drawing from the answers from the respondents, the recommendation of the study is divided into two parts – recommendations for practical purpose and recommendations for further research study in the area.

5.2.1 General Recommendations for Practical Purpose

Figure 20: Addressing the challenges of oil spill and preparedness in Sierra Leone

What do you think should be done to overcome the challenges you mentioned above in controlling oil spill and preparedness?

Category	Percentage
Political leadership	11%
Working with other countries	5%
Prioritize oil spill preparedness andresponse	21%
Sensitize all stakeholders	5%
Provision of tools/equipment	11%
Update current laws & enforce implementation	21%
Adequate training for personnel	26%

Source: *Field data, 2020*

Data from respondents suggest the actions be taken to address the challenges of oil spill preparedness and response:

- Provide adequate training for personnel's as reported by 26% of respondents followed by;
- 21% for updating of current laws and their enforcement and prioritizing oil spill preparedness and response and then;
- 11% reported the provision of essential tools and equipment and political leadership and;
- 5% each for sensitizing all stakeholders in the sectors and establishing working relationships with other countries in the region and beyond

Critically, the respondents further proposed the following actions on awareness training and human resource development must be taken:

"The delegated authorities or line agencies must endeavour to sensitize the attorney general's office, concerned ministries, departments and agencies and the parliamentarians' Committee for transport to appreciate the risk in ranking the domestication of international oil spill conventions as low priority".

"Government and its line ministries should invest in building human capital resources in oil risk management through the giving of academic scholarships to students and professionals".

"Prior inspection of oil carrying vessels to ascertain safety, sea worthiness and oil spill risk".

Figure 21: Recommendations to the Sierra Leone Maritime Administration

What are your recommendations to the Sierra Leone Maritime Administration in order to improve preparedness and response to oil spills?

- Offer professional advice to government: 5%
- Environmental protection: 5%
- Strenthen collaboration with local and international partners: 25%
- Development of legal framework & their enforcement: 15%
- Leadership: 10%
- Resource Availability: 10%
- Training/human capital development: 30%

Source: *Field data, 2020*

Respondents report the following recommendations for the Sierra Leone Maritime Administration:

- Support trainings and human and human capital development in the country as reported by 30% of respondents which is followed by;
- Strengthening collaboration with local and international partners as reported by 25%,
- Development of legal framework and their enforcement as reported by 15%,
- Leadership and resource availability is reported by 10% respectively.

Also, it is very relevant that key findings of the study are the following recommendations:

"Work with other regulatory bodies and partners to enforce implementation of national and international oil spill regulations in the country without favouritism".

"The Sierra Leone Maritime Administration should endeavour to liaise other oil producing countries in the sub-region and even the Asian blocks and tap their experience and laws and regulations on such. It is also advisable to seek support from selected countries in Europe and America and seek support for this emerging challenge. Sierra Leone as a country do not have to wait until the occurrence of such spillage before reacting. There is need to be pro-active and be ready for any future eventuality".

Figure 22: Recommendations to the Government of Sierra Leone

What are your recommendations to the government of Sierra Leone in order to improve preparedness and response to oil spills?

Category	Percentage
Creational of national structures	5%
Establish bilateral & Multilateral relationship with other governments	5%
Provide political leadership	24%
Build technical capacity of personnels	10%
Review/Enforce implementation laws	19%
Strengthened the JMC	5%
Budgetary Allocation	33%
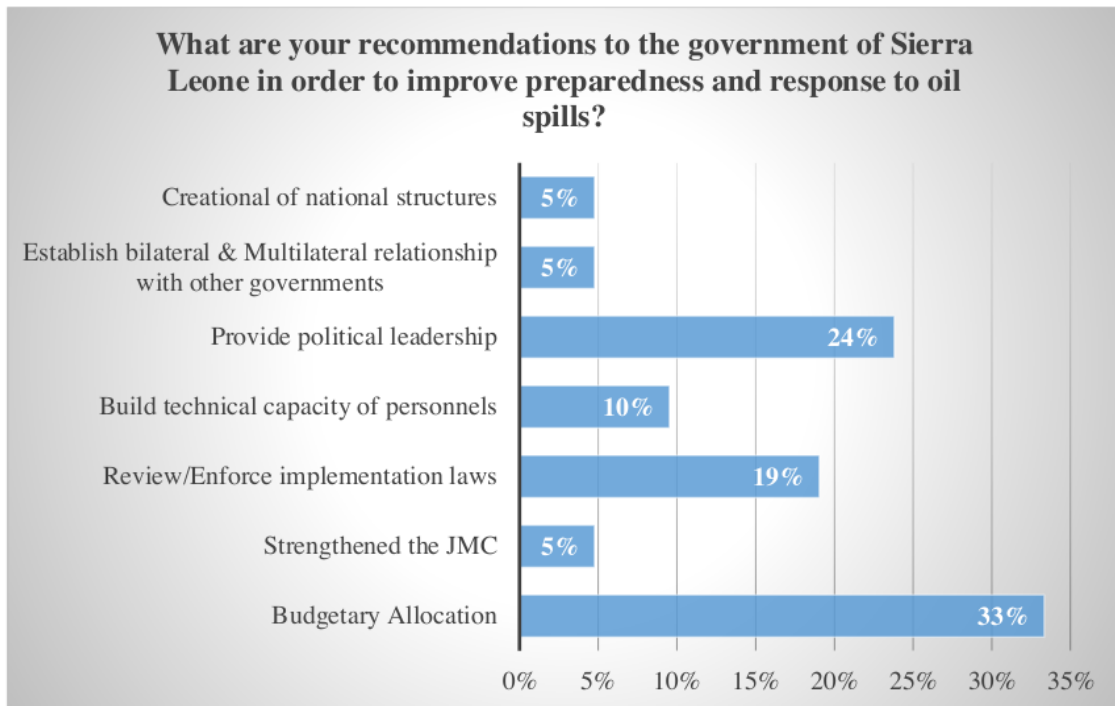
Source: *Field data, 2020*

Data collected from respondents reports the following recommendations to the government of Sierra Leone as follows:

- 33% report that government should increase budgetary allocation to the

responsible Ministry,

- 24% report that the political leadership for oil spill preparedness and response should be provided,

- 19% report on the need to review existing laws and enforce their implementation,

- 10% report on the need to build the technical capacity of personnel's in the country.

On the basis of best international practice, the researcher however proposes the following additional recommendations:

- Government and the relevant stakeholders should ensure to carry out a more recent national oil spill risk assessment exercise across all the EEZ of Sierra Leone in the immediate short-term. This exercise will help provide accurate and current information for immediate action and implementation.

- As revealed in the research findings, as a country to-date there exist no data on the possible cost burden of a major oil spill in the country. The lack of data affects governments priority spending and focus. Therefore, to better plan and budget adequately for an outbreak of an oil spill, decision-making should be supported by statistically data evidence. Information derived from recent spills in Mauritius and the Petrotrin oil spill in Trinidad and Tobago could be used for this purpose with the help of expert advice and modeling.

- Efforts should be made by government and its stakeholders to follow IMO best practice guidance that meet the essential elements to an oil preparedness and response plan. That is, developing an incident management system, tiered oil spill response approach and sensitivity mapping amongst others.

References

Aaker, K. & Day, (1998). *Research methods for political science: quantitative and qualititative approaches*. 2nd ed. The new realities. London: The Croswell Press, Wiltshire.

Al Shami, A., Harik, G., Alameddine, I., Bruschi, D., Garcia, D. A., & El-Fadel, M. (2017). Risk assessment of oil spills along the mediterranean coast: A sensitivity analysis of the choice of hazard quantification. *Science of the Total Environment, 574*, 234-245. doi: 10.1016/j.scitotenv.2016.09.064

Al-Majed, A A, A R Adebayo and M E Hossain (2012). A sustainable approach to controlling oil spills. *Journal of Environmental Management, 113*, 213-227

Asdpour, R., Sapari, N. B., Tuan, Z. Z., Jusoh, H., Riahi, A., & Uka, O. K. (2013). Application of sorbent materials in oil spill management: A review. *Caspian Journal of Applied Sciences Research, 2*(2), 46-58.

Atubi, A. O, (2015). Effects of oil spillage on human health in producing Communities of Delta state, Nigeria. *European journal of business and social sciences*, 14 – 30

Ayuba, K. A. (2012). Environmental impacts of oil exploration and exploitation in the Niger Delta of Nigeria. *Global Journal of Science Frontier Research* .

Badejo, O. T and Nwilo. P .C (2008): Impacts and management of Oil Spill Pollution along the Nigeria Coastal Areas.
Available at: https://www.fig.net/pub/figpub/pub36/chapters/chapter_8.pdf.

Cardona. (2012). Determinants of risk: Exposure and vulnerability. Retrieved from https://www.researchgate.net/publication/244062037_Determinants_of_risk_exposure_andvulnerability

Chang, S. E., Stone, J., Demes, K., & Piscitelli, M. (2014). Consequences of oil spills: a review and framework for informing planning. *Ecology and Society*, 19(2).

Chindo, M. I. (2011). Communities Perceived Socio-economic impacts of oil sands extraction in Nigeria. *Journal of Studies & Research in Human Geography*, 5(2): 69-77.

Colborn, T., Kwiatkowski, C., Schultz, K., & Bachran, M. (2011). Natural gas operations from a public health perspective. *Human and Ecological Risk Assessment: An International Journal*, 17(5), 1039-1056.

De Oliveira, Sandra Rita, "A rational implementation of the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990, in Brazil" (1999). World Maritime University Dissertations. 1089. https://commons.wmu.se/all_dissertations/1089

Ekoh, S. S. (2015). Economic effects of oil and gas development on child health in Colorado (Masters degree - Colorado State University, Fort Collins).

Ekwugha, U. E. (2014). The management of oil spillage in the Niger Delta region of Ngeria (Masters dissertation - University of South Wales).

Environmental Protection Agency Sierra Leone. (2017). *Sierra Leone's Second National Biodiversity Strategy and Action Plan 2017-2026*. Freetown: Government of Sierra Leone.

Environmental Protection Agency, (2015). *State of the Marine Environment Report 2015*, Freetown: Government of Sierra Leone.

European Parliament. (2011). *The effects of oil companies' activities on the environment, health and development in Sub-Saharan Africa*. Belgium: Directorate-General for External Policies of the Union-Policy Department.

Fartoosi, F. m. (2013). The impact of maritime oil pullution in the marine environment: case study of maritime oil pollution in the navigational channel of Shatt Al-Arab (World Maritime University Dissertation. 318).

Gay, J., Shepard, O., Thyden, M., & Whitman, M. (2010). The health effects of oil contamination: A compilation of research (The Worcester Polytechnic Institute).

giwacaf. (2016). *National workshop and exercise on contingency planning and incident management system (IMS) freetown, sierra leone 6 - 9 june 2016*.
Retrievedfrom file:///Users/papzoo/Downloads/national-workshop-and-exercise-on-contingency-planning-and-incident-management-system.pdf
Groenhuis, S. (1981). *Tanker incidents*

Hou, L., Zhang, X., Wang, D., & Baccarelli, A. (2011). Environmental chemical exposures and human epigenics. *International Journal of Epidemiology, 41*(1). 1-27. doi:10.1093/ije/dyr15

Hulsey & Ludivina. (2012). *Marine Pollution*. New Delhi: World Technologies.
IMO. (2010). Manual on oil spill risk evaluation and assessment of response preparedness.
Retrieved from:
https://vp.imo.org/Customer/Subscriptions/IMOVega/res/pdf/MANOILSPILLMAN.pdf
IMO. (2016). IMO OPRC Implementation guide. *Implementation of the OPRC Convention and*
the OPRC-HNS protocal and relevant conference resolutions (pp. 1-4). Norway: IMO.

International Maritime Organization. (2010). Manual on oil spill risk evaluation and assessment
of response preparedness.
http://parlinfo.aph.gov.au/parlInfo/search/summary/summary.w3p;query=Id:%22library/lcatalog/00158990%22

IPIECA-IOGP (2015). *Response strategy development using net environmental benefit analysis*

(NEBA). IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry
　　　　Project.
　Available online at:
http://www.oilspillresponseproject.org/wpcontent/uploads/2016/02/GPGNet-
　　　　Environmental
Benefit-Analysis.pdf.

Ipingbemi, O. (2009). Socio-economic implications and environmental effects of oil
　　　　spillage in some communities in the Niger delta. *Journal of Integrative*
　　　　Environmental Sciences, 6(1), 7-23.

Ite, A. E., Ufot, U. F., Ite, M. U., & Idongesit O. Isaac, U. J. (2016). Petroleum industry
　　　　in Nigeria: Environmental issues, national environmental legislation and
　　　　implementation of international environmental law. *American Journal of*
　　　　Environmental Protection, 21-37.

ITOPF. (2011). *Effects of oil pollution on social and economic activities*. Canterbury, Uk:
　　　　ITOPF.

ITOPF. (2011). *Effects of oil pollution on the marine environment*. Retrieved April, 2013,
　　　　from: www.itopf.com/.../TIP13EffectsofOilPollutionontheMarineEnvironment

ITOPF. (2014). *Use of booms in oil pollution response*. London: ITOPF. Retrieved from
　　　　http://www.itopf.org/knowledge-resources/documents-guides/document/tip-03-
　　　　use-of-booms-in-oil-pollution-response/

ITOPF. (2014). *Use of booms in oil pollution response*. London: ITOPF. Retrieved from
　　　　http://www.itopf.org/knowledge-resources/documents-guides/document/tip-03-
　　　　use-of-booms-in-oil-pollution-response/

ITOPF. (2014). *Use of dispersants to treat oil spills*. London: ITOPF. Retrieved from
　　　　http://www.itopf.org/knowledge-resources/documents-guides/document/tip-04-
　　　　use-of-dispersants-to-treat-oil-spills/

ITOPF. (2014). *Use of dispersants to treat oil spills*. London: ITOPF. Retrieved from
　　　　http://www.itopf.org/knowledge-resources/documents-guides/document/tip-04-
　　　　use-of-dispersants-to-treat-oil-spills/

ITOPF. (2019). *Oil tanker spill Statistics 2019*. London: ITOPF Limited.

Katsouris, C. and Sayne, A., (2013). Nigeria's Criminal Crude: International Options to
　　　　Combat the Export of Stolen Oil. London: Chatham House.

Laffon, B., Pasaro, E., & Valdiglesias, V. (2016). Effects of exposure to oil spills on
　　　　human health: Updated review. *Journal of Toxicology and Environmental health,*
　　　　Part B, 105-128.

Larkin, S. L., R. G. Huffaker, & R. L. Clouser. (2013). Negative Externalities and Oil Spills: A Case for Reduced Brand Value to the State of Florida. *Journal of Agricultural and Applied Economics* 45(3): 389–399.

Lee, C.-H., Y.-A. Kang, K.-J. Chang, C.-H. Kim, J.-I. Hur, J.- Y. Kim, and J.-K. Lee. (2010). Acute health effects of the Hebei oil spill on the residents of Taean, Korea. Journal of Preventive Medicine and Public Health 43:166–73. doi:10.3961/jpmph.2010.43.2.166.

Lee, H. (2011). Impacts of oil spills: Ecological, Human Health and Economic (Plan 2 Honors program - The University of Texas, Austin).

Martins, H., (1996). *Data analysis: processing and basic analysis,.* Pretoria: University of South Africa.

McGovern, J. (2008). *Letter to The Honorable Barack Obama President-Elect of the United States.* Retrieved April 10, 2020 from http://mcgovern.house.gov/uploads/scan001.PDF

Michael, A. (2018). Oil spills and their impact on the Niger Delta (Bachelor of Science thesis; Helsinki Methropolia University of Applied Sciences).

Mobil Producing Nigeria. (1998). January 1998 Idoho – QIT 24 pipeline oil spill. Short term environmental impact assessment report. Nigeria: Mobil Producing Nigeria.
Moller, T. H., Molloy, F. C., & Thomas, H. M. (2003, April). Oil spill risks and the state of preparedness in the regional seas. In *International Oil Spill Conference* (Vol. 2003, No. 1, pp. 919-922). American Petroleum Institute.

Muthike, S. N. (2018). Assessment of Kenya's capacity to effectively prepare for and respond to oil spill incidents. *Assessment*, *11*, 4-2018.

Muthike, Stellamaris Ndeve, "Assessment of Kenya's capacity to effectively prepare for and
respond to oil spill incidents" (2018). World Maritime University Dissertations. 680. https://commons.wmu.se/all_dissertations/680

Neiland, A. E., Cunningham, S., Arbuckle, M., Baio, A., Bostock, T., Coulibaly, D., ... & Sei, S.
(2016). Assessing the potential contribution of fisheries to economic development—The case of
post-Ebola Sierra Leone. *Natural Resources*, *7*(6), 356-376.

O'Rourke D and Connolly S, (2003). Just Oil? The Distribution of Environmental and Social Effects of Oil Production and Consumption. *Annu.Rev.Environ.Resour.2003*.28:587-617

Obenade, M. and Amangabara, *G. T., (*2014). The Socioeconomic Implications of Oil Theft and Artisanal Refining in the Niger Delta Region of Nigeria. International *Journal of Science and Research (IJSR)*, Volume 3, Issue 7, 2390 – 2394.

Obeng, O.F. (2010). Avoiding the oil curse in Ghana: Is transparency sufficient? *African Journal of International Affairs*, 13(1&2): 89-119.

Ogbogbo CBN. (2004). The Niger delta and the resource control conflict since 1960– 1995 [Ph.D. Institute of African studies dissertation]. Nigeria: University of Ibadan.

Omorede, C. K. (2014). Assessment of the impact of oil and gas resources exploration on the environment of selected communities in Delta State, Nigeria. *International Journal of Management, Economics and Social Sciences*, 79-99.

OPRC convention: International convention on oil pollution preparedness, response and co-operation, 1990 (1991). . London:

Owabukeruyele, W.S. (2009). Hydrocarbon Exploitation, Environmental Degradation and Poverty in the Niger Delta Region of Nigeria. Lund University. Sweden. [January 30, 2000]. [Online] Available: mhtml: file//E:\ oil spill information for literature review.mht.

Richardson, R. B., & Brugnone, N. (2018). *Oil spill economics: Estimates of the economic damages of an oil spill in the Straits of Mackinac in Michigan.* Michigan State: For Love of Water.

Robert Bryne. The impact of oil spills: Research Briefing April 2019 https://www.assembly.wales/Research%20Documents/022%20%20Oil%20Spills/022%20-%20Web%20-%20English.pdf

Roland H.& Anna B (2017). The Effect of Oil Spills on Infant Mortality: Evidence from Nigeria. CESifo working paper Series no. 6653. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3043605

Saadoun, I. M. (2015). Impact of oil spills on marine life. Emerging Pollutants in the Environment-Current and Further Implications, 77.

Sako, E. B. (2017). Public health implications of oil pullution in Koluama: Nigeria (Doctoral Dissertation, Walden University.

Seager, T. P., Satterstrom, F. K., Linkov, I., Tuler, S. P., & Kay, R. (2007). Typological review of environmental performance metrics (with illustrative examples for oil spill response). Integrated Environmental Assessment and Management: An International Journal, 3(3), 310-321.) Shell, (2014). Oil Theft, Sabotage and Spills. Publication of Shell Companies in Nigeria. Available

at:https://s05.staticshell.com/content/dam/shellnew/local/country/nga/downloads/pdf/2014bnotes/spills.pdf

Singh, A., Asmath, H., Chee, C. L., & Darsan, J. (2015). Potential oil spill risk from shipping and the implications for management in the Caribbean Sea. *Marine Pollution Bulletin*, 93(1-2), 217-227. doi:10.1016/j.marpolbul.2015.01.013

Singhota, G. S. (1995). IMO's role in promoting oil spill preparedness. Spill Science and Technology Bulletin, 2(4), 207-215. doi:10.1016/S1353-2561(96)00007-2

Statistics Sierra Leone, (2015). *Population and Housing Census Report,* Freetown: Statistics Sierra Leone.

Taylor, E., Bjerkemo, O. K., & Taylor, P. (2018). Steps and challenges in the implementation of the OPRC Covention and the OPRC-HNS protocol. *Interspill*, 1-4. Retrieved from http://www.interspill.org/previous-events/2018/14March2018/6-Government-Industry-Partnerships/Steps-and-Challenges-in-the-Implementation-E-Taylor-Polaris-Applied-Sciences.pd

Twumasi, Y., & Merem, E. (2006). GIS and remote sensing applications in the assessment of change within a coastal environment in the Niger Delta region of Nigeria. *International Journal of Environmental Research & Public health*, 98-106.

UNCTAD Review of Maritime Transport 2019
https://unctad.org/en/PublicationsLibrary/rmt2019_en.pdf

Vanem, E., Endresen, Ø., & Skjong, R. (2008). Cost-effectiveness criteria for marine oil spill preventive measures. *Reliability Engineering & System Safety*, 93(9), 1354-1368.

Ventikos, N. P., Vergetis, E., Psaraftis, H. N., & Triantafyllou, G. (2004). A high-level synthesis of oil spill response equipment and countermeasures. *Jounal of Hazardous Materials*, 51-58.

Yuewen, D., & Adzigbli, L. (2018). Assessing the impact of Oil Spills on marine organisms. *Journal of Oceanography and Marine Research*, 2-7.

Zahed, M. A., H. A. Aziz, M. H. Isa and L. Mohajeri.(2010). Effect of initial oil concentration and dispersant on crude oil biodegradation in contaminated seawater. *Bulletin of environmental contamination and toxicology, 84(4):* 438-442. Zhu, H., S. Qiu, W. Jiang, D. Wu and C

Zico Cozier (2020). Marine ecosystems & livelihoods at risk if venezuelan oil tanker sinks. Retrieved from: https://www.caribois.org/2020/09/marine-ecosystems-livelihoods-at-risk-if-venezuelan-oil-tanker-sinks/?fbclid=IwAR0VAjlhvwAqxHyIuuZPy1g5jA7Vzyd9qO133UOdB9Bzf26HWHeq9ahfto

Appendices

Appendix 1: Research Letter of Consent and Questionnaire

Dear interviewee,

I am a student of the World Maritime University (WMU) pursing MSc. in Maritime Affairs Specializing in Maritime Safety and Environmental Administration (MSEA)

In partial fulfilment for the degree or as graduation requirement, I am to submit a dissertation on the topic "The Risk of Oil Spills in the Exclusive Zone of Sierra Leone".

Your agency, I am aware is responsible for the protection of human health, Marine Plant and animal as well as the Coastal and Marine Environment from the risk of Oil spills. In light of the above your organisation has been chosen as Case Study organisation for this research. It is in this light that I request your cooperation in the form of inputs into this research work by filling the attached questionnaire as applies to you. You will not only be assisting the researcher but also contributing to Maritime Sector Reforms in the Country.

While your co-operation is anticipated, any information that will be generated from this study will be treated with utmost confidentiality.

Name of Student: Duramani Kempes

Sesay

April, 2020

Research Questionnaire

Dear Sir/Madam,
I am conducting a research study on the "The Risk of Oil Spills in the Exclusive Economic Zone of Sierra Leone". This research is carried out in partial fulfilment of the requirement for the award of MSc Maritime Affairs. The authenticity of the study will depend on the accuracy of your response; however, any response got from you will be treated with utmost confidentiality. I would therefore appreciate it most, if you could spare some part of your busy schedule to respond to my questions. Thank You!
Kindly answer the questions below

#	QUESTIONS	RESPONSE		Code
GENERAL INFORMATION OF RESPONDENTS				
1.	Sex of respondent.	[1] Male	[2] Female	
2.	Age of respondent.	[1] 20 -25 years [3] 30 – 35 years [5] 40 – 45 years [7] 50 and above	[2] 25 – 30 years [4] 35 – 40 years [6] 45 – 50 years	
3.	Highest Level of Education of respondent.	[1] Certificate [3] Degree [5] Doctorate [7] Others (Specify)………………………………………………	[2] Diploma [4] Masters [6] PhD	
4.	Employment status of respondent.	[1] Managing Director/CEO [3] Manager [5] Others (Specify)………………………………………………	[2] Director [4] Supervisors	
THE RISK OF OIL SPILLS IN THE EXCLUSIVE ECOMONIC ZONE OF SIERRA LEONE				
5.	Does Sierra Leone have any Oil spill	[1] Yes ☐	[2] No ☐	

	preparedness response plan?		
6.	Has the country carried out any Oil spill exercise within the last 6 Months, 1 year, or 3 years?	[1] 6 Months Yes ☐ No ☐ [2] 1 Year Yes ☐ No ☐ [3] 3 Year Yes ☐ No ☐	
7.	If yes to Q6 above; what were the major findings of this exercise?		
8.	What type and number of ships that enters the Exclusive Economic Zone of Sierra Leone?		
9.	How does Oil spills affects the economic zone of Sierra Leone?		
10.	What is the cost burden on Oil spill on the government of Sierra Leone?		
RISK CLASSIFICATION METHODS IN SIERRA LEONE			
11.	What types of Oil spills experienced in Sierra Leone?		
12.	What are the effects of these different types of Oil spills on the social well-being of citizens?		

13.	What are the effects of these different categories of Oil spills on marine environment, as well as aquatic-life?		
RESPONSE EQUIPMENT AND SUPPORTING RESOURCES USED IN SIERRA LEONE			
14.	Does the country have a regulatory framework on Oil spills?	[1] Yes ☐　　　　　　　[2] No ☐	
15.	If yes to Q13 above; how would you describe the implementation of this framework?		
16.	How would you describe the availability of required resources to fight against Oil spills in the country?		
17.	What approaches does the government and it line agencies have in place to control these Oil spill risk?		
THE DIFFICULTIES AND CHALLENGES FACED IN IMPLEMENTING THE INTERNATIONAL CONVENTION ON OIL SPILL PREPAREDBESS, RESPONSE AND COOPERATION (OPRC) IN SIERRA LEONE			
18.	What are the major challenges faced in the implementation of national laws in giving effect to the		

	International Convention on Oil Spill Preparedness, Response and cooperation in Sierra Leone?		
19.	Based on your expertise in Oil spill preparedness and response, please describe the challenges faced by Sierra Leone in Oil spill preparedness and response?		
20.	What do you think should be done to overcome the challenges you mentioned above in controlling Oil spill and preparedness?		
RECOMMENDATIONS			
21.	What are your recommendations to the Sierra Leone Maritime Administration in order to improve preparedness and response to oil spills?		
22.	What are your recommendations to the government of Sierra Leone in order to improve		

	preparedness and response to oil spills?		
23.	Any other comments		
The End! Thank you so much for your participation and time!!!			