

UNIVERSITY OF PORTSMOUTH

The use of selected indicators to  
examine marine fishery sustainability  
within the Nigeria-Sao Tome & Principe  
Joint Development Zone

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**Aliyu Danagalan**

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A Thesis submitted in partial fulfilment of the requirements for the award of the degree of  
Doctor of Philosophy (PhD) of the University of Portsmouth.

# Declaration

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Whilst registered as a candidate for the above degree, I have not been registered for any other research degree award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

Signed ..... (Candidate)                      Date: .....

## Statement 1

This thesis is the result of my own investigations, unless otherwise stated. All other sources have been duly acknowledged. A full reference list is appended therein.

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## Statement 2

I hereby declare that the word count in this thesis is 81,707 words excluding references and appendices.

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# Abstract

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In 1999, the officials of the Nigerian and Sao Tome & Principe's governments embarked upon delineating their maritime boundary. They discovered that the two nations' maritime boundary overlapped as a result of establishing their Exclusive Economic Zone; and this area of overlap was found to have enormous hydrocarbon and non-hydrocarbon resources. Several meetings and negotiations ensued and the area of overlap designated a joint development zone.

The aim of the research is to evaluate the viability and effectiveness of implementing the recently published Transboundary Waters Assessment Programme-Large Marine Ecosystem indicators to the Nigeria-Sao Tome & Principe Joint Development Zone-an area of sub-Large Marine Ecosystem scale- given the characteristics of the zone and particularly the extent of Illegal, Unregulated, and Unreported fishing around the area.

An interview and questionnaire survey was conducted on some selected stakeholders where initial findings revealed a clear lack of information exchange among critical stakeholders, inadequate attention to living resource exploitation in a joint development designated to cover both living and non-living resources, lack of a coherent mechanism to tackle issues of Illegal, Unreported and Unregulated fishing practices among others and most importantly lack of or ignorance on the use and employment of indicators for marine ecosystem assessment as encouraged by scientists.

Results from the survey were further compared and evaluated against international best practices where recommendations emerged. This provided insights and lessons upon further evaluations from examples of successful application of use and deployment of indicators for marine resource assessment especially in joint development context for the research area that are capable of being applicable elsewhere in similar scenarios.

Feedback and comments were later obtained upon the initial analysis from the main stakeholders responsible for the sustainable management of the Joint Development Zone's fishery resources. This was then integrated into the research which provided critical insights and key lessons on the use and employment of indicators as well as on the current management arrangements in place for the sustainable management of the Joint Development Zone's fishery resources.

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Finally, I am equally particularly grateful to my first supervisor, Dr. Jonathan Potts; who jointly supervised this thesis initially with Dr Helen Glenn and Dr Brian Baily. My gratitude also goes to Mr Tim Goodhead and Dr Caroline Day; who came on board towards the end of the PhD to replace Dr Helen Glenn and Dr Brian Baily as second and third supervisor respectively. I thank you all for your guidance, patience and understanding.

# Dedication

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This thesis is dedicated to my parents; **Hajiya Madina Hamza Dan'Agalan** and the **late Alhaji Hamza Dan'Agalan**, for their love, encouragement and unwavering support throughout my entire life AND my entire family for the enormous confidence reposed in me.

# Dissemination

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- Attended 8th Annual Research and Knowledge Exchange Conference by the Portsmouth Business School
- Attended and presented at the Faculty of Science Postgraduate Research Students' Poster Conference
- Attended and presented at the Graduate School Poster Competition after securing nomination upon submission of poster.
- Attended the Maiden London International Boundaries Conference in April, 2013 at the Royal Geographical Society in London.
- Attended and presented a poster at the 2<sup>nd</sup> International Ocean Research Conference at Barcelona titled 'The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ)' from 17<sup>th</sup> to 21<sup>st</sup> November, 2014.
- 'Challenges in applying Transboundary Waters Assessment Programme-Large Marine Ecosystem (TWAP-LME) indicators to the management and assessment of joint marine fishery resources: The Nigeria-Sao Tome & Principe Joint Development Zone (JDZ)'. Abstract accepted for oral presentation at the 4<sup>th</sup> International Conference on Biodiversity holding in Las Vegas, USA from 15<sup>th</sup> to 17<sup>th</sup> June, 2015.
- 'The applicability of the Transboundary Waters Assessment Programme-Large Marine Ecosystem (TWAP-LME) indicators to the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ): an area of sub-LME scale'. An Abstract accepted for oral presentation at the 3<sup>rd</sup> International Conference on Oceanography holding in Philadelphia, USA from 22<sup>nd</sup> to 24<sup>th</sup> June, 2015.

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## **List of Acronyms**

APEC	-	Asia-Pacific Economic Cooperation
BMC	-	Bilateral Military Commission
CBD	-	Convention on Biological Diversity
CBOs	-	Community Based Organisations
CFP	-	Common Fisheries Policy
CITES	-	Convention on International Trade on Endangered Species
COMHAFAT/ATLAFCO	-	Conference on Fisheries Cooperation among African States Bordering the Atlantic
CSD	-	Commission on Sustainable Development
CZCS	-	Coastal Zone Colour Scanner
DEFRA	-	Department of Environment, Food and Rural Affairs
DPR	-	department of Petroleum Resources of Nigeria
DPSIR	-	Driving forces-Pressure-State-Impact-Response
EAF	-	Ecosystem Approach to Fisheries
EBFM	-	Ecosystems Based Fisheries Management
EBM	-	Ecosystems Based Management
ECOWAS	-	Economic Community of West African States
ED-C&I	-	Executive Director-Commercial & Investments of the JDA
ED-NHR	-	Executive Director-Non Hydrocarbons Department of the JDA
EEA	-	European Environment Agency
EEZ	-	Exclusive Economic Zone

EIA	-	Environmental Impact Assessment
EU	-	European Union
EU-WG	-	European Union Working Group on indicators
FAO	-	Food and Agricultural Organisation
FCWC	-	Fisheries Committee of the West Central Gulf of Guinea
FME	-	Federal Ministry of Environment
GCLME	-	Guinea Current Large Marine Ecosystem
GEF	-	Global Environment Facility
GESAMP	-	Group of Experts on Scientific Aspects of Marine Pollution
GOG	-	Gulf of Guinea
GOGC	-	Gulf of Guinea Commission
GDP	-	Gross Domestic Product
GEF FSP	-	Global Environment Facility Full-Sized Project
GEF MSP	-	Global Environment Facility Medium-Sized Project
GIS	-	Geographical Information System
HABs	-	Harmful Algal Blooms
HABSOS	-	Harmful Algal Blooms Observing System
HDI	-	Human Development Index
ICCAT	-	International Council for the Conservation of the Atlantic Tuna
ICES	-	International Council for the Exploration of the Sea
ICZM	-	Integrated Coastal Zone Management

IHP	-	International Hydrological Programme
ILEC	-	International Lake Environment Committee
IMO	-	International Maritime Organisation
IMOCC	-	Inter-Agency Maritime Operation Coordination Committee
IOC-UNESCO	-	Intergovernmental Oceanographic Commission of the United Nations, Educational, Scientific and Cultural Organisation
IPOA-IUU	-	International Plan of Action to Prevent, Deter and Eliminate IUU fishing
ITQ	-	Individual Transferable Quotas
IUCN	-	International Union of the Conservation of Nature
IUU	-	Illegal, Unreported and Unregulated fishing
IVQ	-	Individual Vessel Quotas
JDA	-	Nigeria-Sao Tome & Principe Joint Development Authority
JDZ	-	Nigeria-Sao Tome & Principe Joint Development Zone
JMC	-	Nigeria-Sao Tome & Principe Joint Ministerial Council
LME	-	Large Marine Ecosystem
MARPOL	-	International Convention on the Prevention of Pollution From Ships
MEV	-	Marginal Economic Value
M&I	-	Monitoring and Inspection Department of the JDA
MMO	-	Marine Management Organisation
MPA	-	Marine Protected Area

MSFD	-	Marine Strategy Framework Directive
MP	-	Maritime Policy
MSP	-	Marine Spatial Planning
MSY	-	Maximum Sustainable Yield
NBC	-	National Boundary Commission of Nigeria
NGOs	-	Non-Governmental Organisations
NIMASA	-	Nigerian Maritime Safety and Administration Agency
NIOMR	-	Nigeria Institute of Oceanography and Marine Research
NNPC	-	Nigeria National Petroleum Corporation
NOAA	-	National Oceanic and Atmospheric Administration
NPA	-	Nigerian Ports Authority
OECD	-	Organisation for Economic Cooperation and Development
P & EH	-	Pollution and Ecosystem Health regional activity centre
PTDF	-	Petroleum Technology Development Fund
RACs	-	Regional Activity Centres of the GCLME
RAMSAR	-	Convention on Wetlands
RFO	-	Regional Fisheries Organisations
RFMOs	-	Regional Fisheries Management Organisations
RMAC	-	Regional Maritime Awareness Capability Centres
SAP	-	Strategic Action Programme
SeaWiFS	-	Sea viewing Wide Field of view sensor
SIDS	-	Small Island Developing States

SST	-	Sea Surface Temperature
STP	-	Democratic Republic of Sao Tome & Principe
SUB-LME	-	An area less than the size of a typical LME
SDRS	-	Sustainable Development and Reference System
TAC	-	Total Allowable Catch
TDA	-	Transboundary Diagnostic Analysis
TURF	-	Territorial Use Rights in Fisheries
TWAP-LME	-	Transboundary Waters Assessment Programme-Large Marine Ecosystem
UK	-	United Kingdom
UN	-	United Nations
UNCED	-	United Nations Conference on Environment and Development
UNCLS	-	United Nations Commission on the Limits of Continental Shelf
UNDP	-	United Nations Development Programme
UNEP	-	United Nations Environment Programme
UNGA	-	United Nations General Assembly
UNIDO	-	United Nations Industrial Development Organisation
USA	-	United States of America
VMS	-	Vessel Monitoring Service
VOS	-	Voluntary Observing Ship Programme
WACAF	-	West and Central African Action plan for the protection of

The coastal and marine environment

WCMC	-	World Conservation Monitoring Center
WDPA	-	World Database on Protected Areas
WG-ID	-	EU Working Group on Indicators and Data
WSSD	-	World Summit on Sustainable Development

## Chapter One: Introduction

### 1.1 Introduction

This chapter will introduce the research by highlighting its location, the research area, the management structure of the area, the rationale behind it, background and historical contexts. It will feature the research methodology, the scope and limitations of the research as well as the structure of the thesis. It will also contain the aim and objectives of the research and highlight the overall contribution of the research.

#### 1.1.1 The Gulf of Guinea Marine Environment

The Guinea Current Large Marine Ecosystem (GCLME) is situated within the Gulf of Guinea (GOG) marine environment as shown in Figure 1.0



Figure 1.0-Map of the GCLME countries (Source: Productivity Center, Ghana)

It is among the five most productive marine ecosystems in the world, namely; the Humboldt Current, the North Sea, the Baltic Sea, the Guinea Current and the Canary Current large marine ecosystems that have abundant fishery resources,

immense oil and gas production and a region of critical importance to marine biological diversity (Chukwuone et al., 2009). It covers a vast marine area spanning from Bissagos Island (Guinea Bissau) in the north to Cape Lopez (Gabon) and Angola in the south inclusive of the Exclusive Economic Zones (EEZ) of sixteen countries as shown in Table 1.0 (Ukwe, Ibe & Sherman, 2006).

Table 1.0-List of GCLME countries and their EEZs sizes (Source: Author's own)

GCLME Countries	EEZ in Km <sup>2</sup>
Angola	330,000
Benin Republic	27,100
Cameroun	15,400
Congo	60,000
Cote d'Ivoire	104,600
Democratic Republic of Congo	1,000
Gabon	213,000
Ghana	218,100
Equatorial Guinea	283,200
Guinea	71,000
Guinea Bissau	156,500
Liberia	229,700
Nigeria	210,900
Sao Tome & Principe	160,000
Sierra Leone	165,700
Togo	2,100

This is a region of immense importance and supports the livelihoods of many communities living along the coast. Over 40% of the approximately 300million inhabitants of the region live along the coast, and are dependent on the lagoons, estuaries and creeks surrounding them for subsistent fishery (Chukwuone et al., 2009). However, the area is also found to be invaded by the activities of Illegal, Unregulated and Unreported (IUU) fishing activities with its attendant economic losses to the countries in the region in addition to the degradation of the ecosystem's health (Falaye, 2008).

### **1.1.2 Challenges of IUU fishing around the Gulf of Guinea**

IUU fishing may be defined as fishing conducted illegally, whose catches are unreported and are by fishing fleets not under regulations of the subsisting fishery organisation of the area that is being conducted (Sumaila & Keith, 2006).

IUU fishing generally affects fisheries sustainability, deters achievement of set goals and has been documented to occur both on the high seas and less policed EEZs (Sumaila & Keith, 2006). This has led to growing concerns from governments and the scientific community into fisheries sustainability in terms of ocean's health and revenues accruable (Sumaila & Keith, 2006; Polacheck, 2012).

Any coastal state has the right, duty and legal capacity to effectively manage fisheries within its area of national jurisdiction as enshrined in United Nations Convention on the Law of the Sea (UNCLOS). However such an area may be very large and remote thereby making the detection and prevention of IUU fishing difficult or impracticable (Bray, 2000). This is often more so within developing countries due to lack of arrangements and resources.

The waters off the coast of West Africa are among the world's richest in terms of fishery resources such as finfish, crustaceans and molluscs while the fishing communities are among the most impoverished and thus vulnerable to IUU fishing by foreign fleets (Falaye, 2008). It has also been reported by Falaye, (2008) that Chinese and Korean vessels spend weeks pillaging the seas off the Atlantic coast. They do so by capitalising on the lax policing situation and in pursuit of land shrimp, lobster and snapper worth \$10,000 per boat per day while estimate of IUU fish loss per boat per year has been put at \$3,000,000 in the sub-region (Falaye, 2008).

One of the responses to sustainability concerns in terms of transboundary marine fishery resources is the adoption of UNCLOS in 1982 and the subsequent 1995 UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks (Garcia & Hayashi, 2000). This ushered in and strengthened the principles of ecosystem based management in addition to prevention of IUU fishing most especially in some developed countries such as the UK and the United States (Garcia & Hayashi, 2000).

### 1.1.3 The research area

The Nigeria-Sao Tome & Principe Joint Development Zone (JDZ) is an area agreed and delineated within the Guinea Current Large Marine Ecosystem (GCLME) along the Gulf of Guinea by the two nations as a result of overlapping territorial claims in establishing their Exclusive Economic Zones (EEZ).

The delineation of the area led to the signing of a joint development treaty (see Appendix One) in 2001 valid for 45 years and subject to review after 30 years for the joint exploration and exploitation of these resources on a 60/40 percentage ratio in favour of Nigeria. The JDZ area is approximately 34,450 square kilometres as shown in Figure 1.1

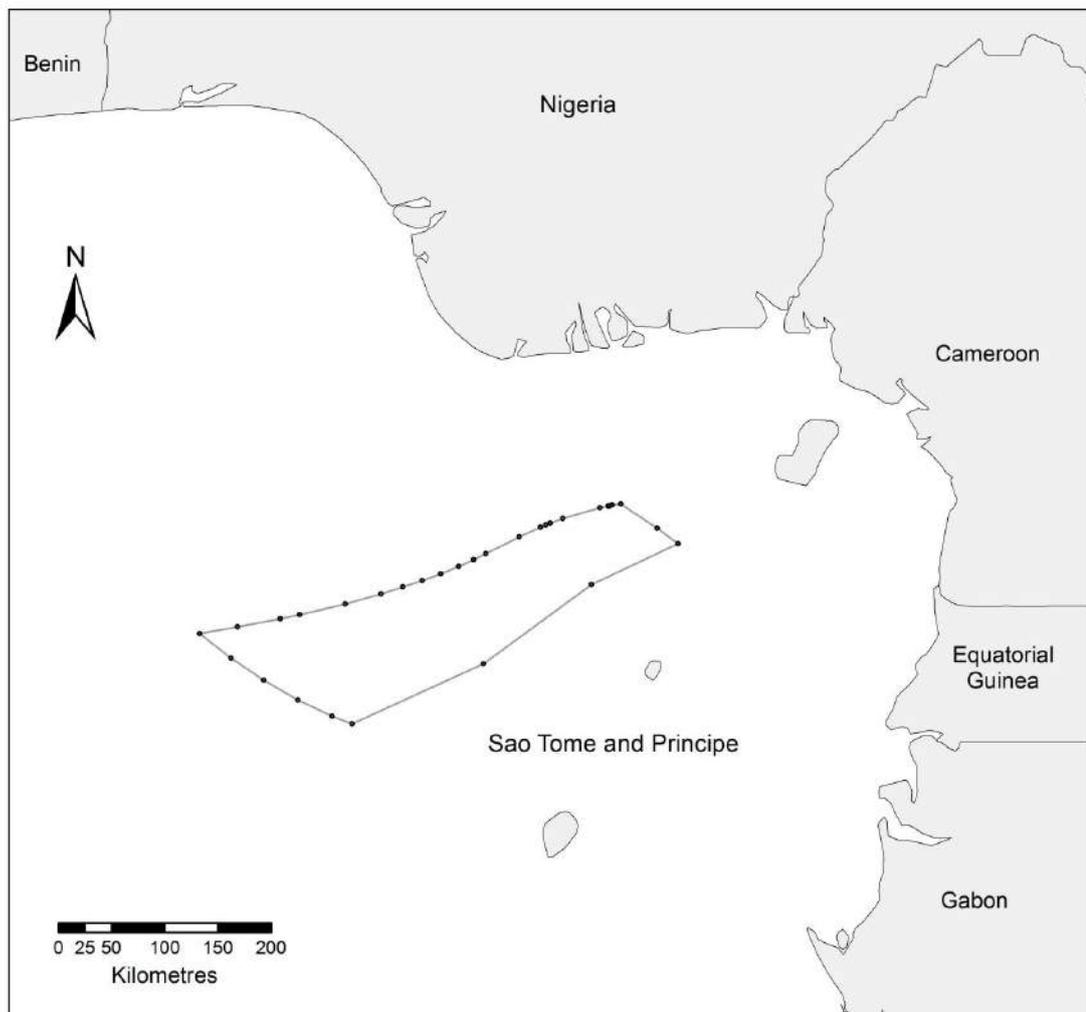


Figure 1.1 – The agreed area of the JDZ in dotted lines. (Source: Author's own)

As a consequence, the signing of the treaty led to the formation of the Joint Development Authority (JDA) as a sole management institution charged with the responsibility of managing the resources of the JDZ on behalf of the two states.

#### 1.1.4 The management structure of the Joint Development Zone

The JDA is made up of four departments under a chairman as visualised in Figure 1.2:

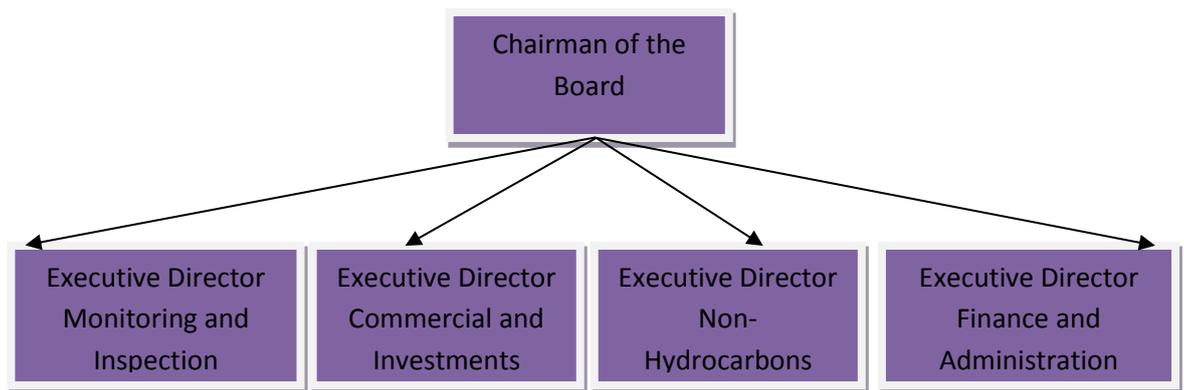


Figure 1.2-Structure of the JDA Board (Source: Author's own)

The board of the JDA is answerable to the Joint Ministerial Council (JMC) made up of two ministers each from the two countries; while the JMC is answerable to the heads of the two states.

## 1.2 Rational for the research

The objectives of Chapter 17, Agenda 21 of the United Nations Conference on Environment and Development (UNCED) of 1992 encouraged nation states, in the spirit of cooperation to enter into a joint development arrangement over their maritime disputed resources with a view to maximising the benefits accruable therefrom for the common benefits of their people pending the determination and delineation of their maritime boundaries (Agenda 21, 1992). Similarly, article 74(3) of UNCLOS III requires that States with opposite coasts, in a similar spirit of understanding and cooperation, to make every effort, pending agreement on delimitation, to enter into provisional arrangements of a practical nature, which should not jeopardise or hamper the reaching of final agreement on the

delimitation of their Exclusive Economic Zones (Garcia & Hayashi, 2000; Uitto & Duda, 2002; Umar, 2002).

### **1.2.1 Background and research context**

In 1999, the officials of the Nigerian and Sao Tome & Principe's governments embarked upon delineating their maritime boundary. They found that the two nations' maritime boundary overlapped as a result of establishing their Exclusive Economic Zones (EEZ).

Internationally, nation states that have overlapping claims over offshore transboundary marine resources are encouraged to enter into a joint development arrangement of such resources for their mutual benefits as depicted in Figure 1.3 (Garcia & Hayashi, 2000). This is supported by the objectives of Chapter 17, Agenda 21 of the UNCED as well as UNCLOS III which promotes sustainable, integrated use and management of marine living resources of the EEZ, high seas and under national jurisdictions (Juda, 1986; Miyoshi, 1988; Garcia & Hayashi, 2000; Joyner, 2000).

The existence of a considerable overlap between the territorial claims of the two countries over their respective maritime boundaries brought about the need for boundary negotiation for settlement (Umar, 2002; NBC et al., 2009). The Nigerian EEZ law of 1978 was based on the principle of median line and modified in 1998 by decree No.41; while the Democratic Republic of Sao Tome and Principe had its 'Official Maritime Claims' law ratified. Subsequently, the two countries deposited their instruments at the United Nations in March 1998 on failing to arrive at a consensus (Umar, 2002; NBC et al., 2009).

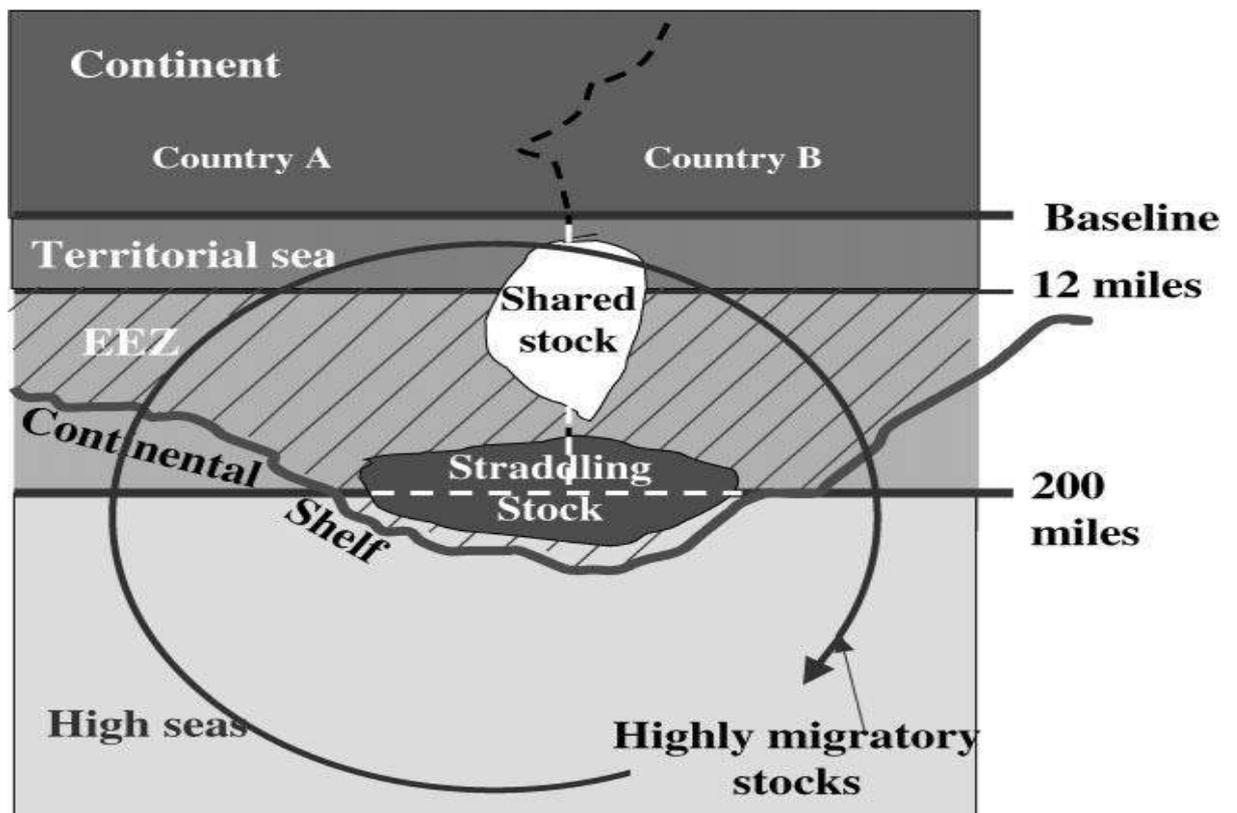


Figure 1.3- Maritime zones and distribution of shared, straddling and highly migratory fish stocks (Source: Garcia & Hayashi, 2000)

### 1.2.2 Historical context

The third United Nations Convention on the Law of the Sea (UNCLOS III) conference which came into force in 1994 ushered in a global comprehensive framework for the management of marine resources. Here it was agreed for coastal states to extend their jurisdictions seaward from 12 Nautical miles to 200 Nautical miles. This extension is referred to as the Exclusive Economic Zone (EEZ). The main objective of establishing the EEZ is to enhance the conservation and sustainable development of global marine resources (Lauck, Clark, Mangel & Munro, 1998).

One of the main challenges for coastal states is how to ensure the optimal preservation of their region's coastal and marine resources and ecosystems, while exploiting them in a sustainable manner in order to drive their national development processes (Uitto & Duda, 2002). This is imperative to ensure sustainable development and management of marine resources that are transboundary in nature, cut across national jurisdictions and from an ecosystem based perspective (Sherman, 1995). As such the two countries agreed to jointly

exploit their resources together in line with the provisions of UNCLOS III and objectives of Chapter 17, Agenda 21 pending the delimitation of their maritime boundary.

### **1.2.3 Aim and objectives**

The aim of the research is to evaluate the viability and effectiveness of implementing the Transboundary Waters Assessment Programme-Large Marine Ecosystem (TWAP-LME) indicators to the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ) given the characteristics of the JDZ and particularly the extent of Illegal, Unregulated, and Unreported (IUU) fishing around the area.

This was achieved through the following objectives: -

1. To critically evaluate marine sustainability indicators designed for sustainable management and development of marine fishery resources.
2. To critically examine the current arrangement for the sustainable management of the shared marine fishery resources within the JDZ and identify the key challenges faced.
3. To evaluate the feasibility of implementing the TWAP LME marine fishery sustainability indicators within the JDZ in the light of the current arrangements and challenges.
4. To develop recommendations for the improvement of marine fishery sustainability within the JDZ and provide lessons for similar scenario.

### **1.3 Research methodology**

The research was conducted through five main steps, namely; literature review and desktop study, case study approach, questionnaires and interviews surveys, their analyses and the selection and evaluation of indicators as visualised in Figure 1.4

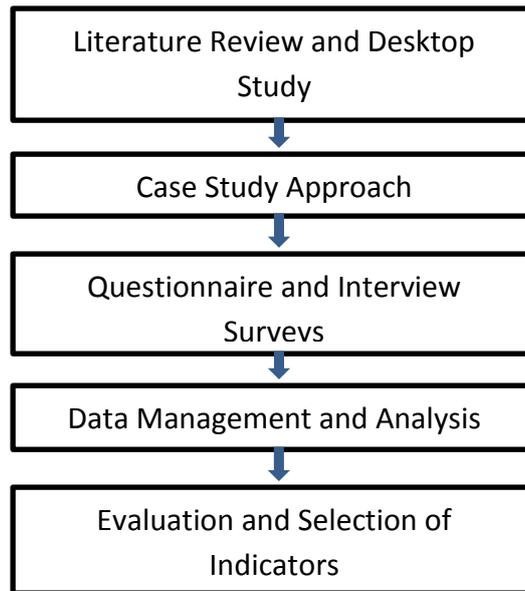


Figure 1.4-Methodological Flow diagram

(Source: Author's own)

### 1.3.1 Literature review and desktop study

A literature review on the conceptual, theoretical and practical bases of marine resource management was undertaken. This provides the historical evolution, characteristics of marine resource management and contemporary approaches. It was also to evaluate key issues within the marine environment, and most especially as they affect the transboundary marine living resources across national jurisdictions. Simultaneously, a desktop study regarding the various international treaties, statutes and conventions governing the management and the jurisdictions of the transboundary marine living resources was equally undertaken as reflected in Chapters Two and Three.

### 1.3.2 Case study approach

The use of a case study approach is justified because the research investigated an arrangement within a particular marine geographical location between two nation states EEZs. This is because the location of the research area is deep offshore and the investigator has little or no control over the location (Yin, 2003) and also the study entailed a 'how' question. This was carried out to generate insights and recommendations capable of answering the 'how' question in addition to being replicable elsewhere in a similar scenario.

### **1.3.3 Questionnaire and interview surveys**

Due to the uniqueness of the JDZ and the fact that not much is known from the literature regarding the marine living resources that thrive in the area; an open-ended survey was designed in order to generate sufficient data on what happens there, who does what and why. The questions were constructed around five main themes, namely;

- The management structure,
- The management policies adopted for the JDZ fisheries,
- The Nature of fishing within the JDZ,
- The Nature of IUU fishing around the JDZ and
- The level of awareness/employment of indicators (see Appendix Two for interview and questionnaire questions).

The survey (comprising of questionnaires and face to face interviews) was administered to a range of key stakeholders (see Section 5.8 and Appendix Three for details) across four different countries, namely; Nigeria, Sao Tome & Principe, Ghana and Angola to generate data.

### **1.3.4 Data management and analysis**

The data was managed using Microsoft Access 2007, a relational database which allowed the data to be stored, organised and manipulated. It was transcribed into 'tables' for each of the stakeholders based on the five main themes and for all of the questions. 'Queries' were generated to decipher relationships from across the range of respondents, out of which clear 'forms' emerged. This enabled 'reports' to be generated based on the relationships and positions of each of the stakeholders. Lastly the data was analysed using 'content analysis' and is reported in Chapters Five and Six.

### **1.3.5 Evaluation and selection of indicators**

Although the aim of the research is to test the viability of applying the TWAP-LME indicators to the JDZ; other similar indicators were evaluated alongside the chosen ones so as to highlight their strengths and weaknesses as well as relevance to the research area. The TWAP-LME indicators were afterwards transmitted to the main

stakeholder (the JDA) alongside indicator development requirements as well as criteria for scoring for them. This was for consultations and their assessments in line with the principle of stakeholder engagement in the development of indicators (Rice & Rochet, 2005; Rochet & Rice, 2005; Potts, 2006; Beliaeff & Pelletier, 2011). (See Appendix Four for feedback and comments request documents).

#### **1.4 Scope and limitations of the research**

The scope of the research covers the analysis of stakeholders' position on the viability of implementing the TWA-LME indicators to the JDZ through their views, opinions and perceptions. It also covered the current level of deployment of the TWAP-LME indicators to the JDZ based on the practitioners' current fisheries management arrangements through a qualitative investigation. As such it was limited to the identified stakeholders' narrations on the use and employment of indicators.

#### **1.5 Structure of the research**

The thesis is structured into four main parts as visualised in Figure 1.5.

Part One contains the conceptual and practical bases of marine resource management; which comprises of Chapters One, Two and Three representing the introduction, marine resource management: theoretical considerations and marine resource management in practice respectively.

Part Two contains the methodological considerations; which comprises of Chapters Four and Five representing the case study approach and case study applications respectively.

Part three contains the analyses and evaluation; which comprises of Chapters Six and Seven representing questionnaire and interview surveys analyses as well as the evaluation of indicator performance against other models respectively.

Part four contains the implications, recommendations and conclusions; which comprises of Chapters Eight and Nine representing viability assessments and conclusions and recommendations respectively.

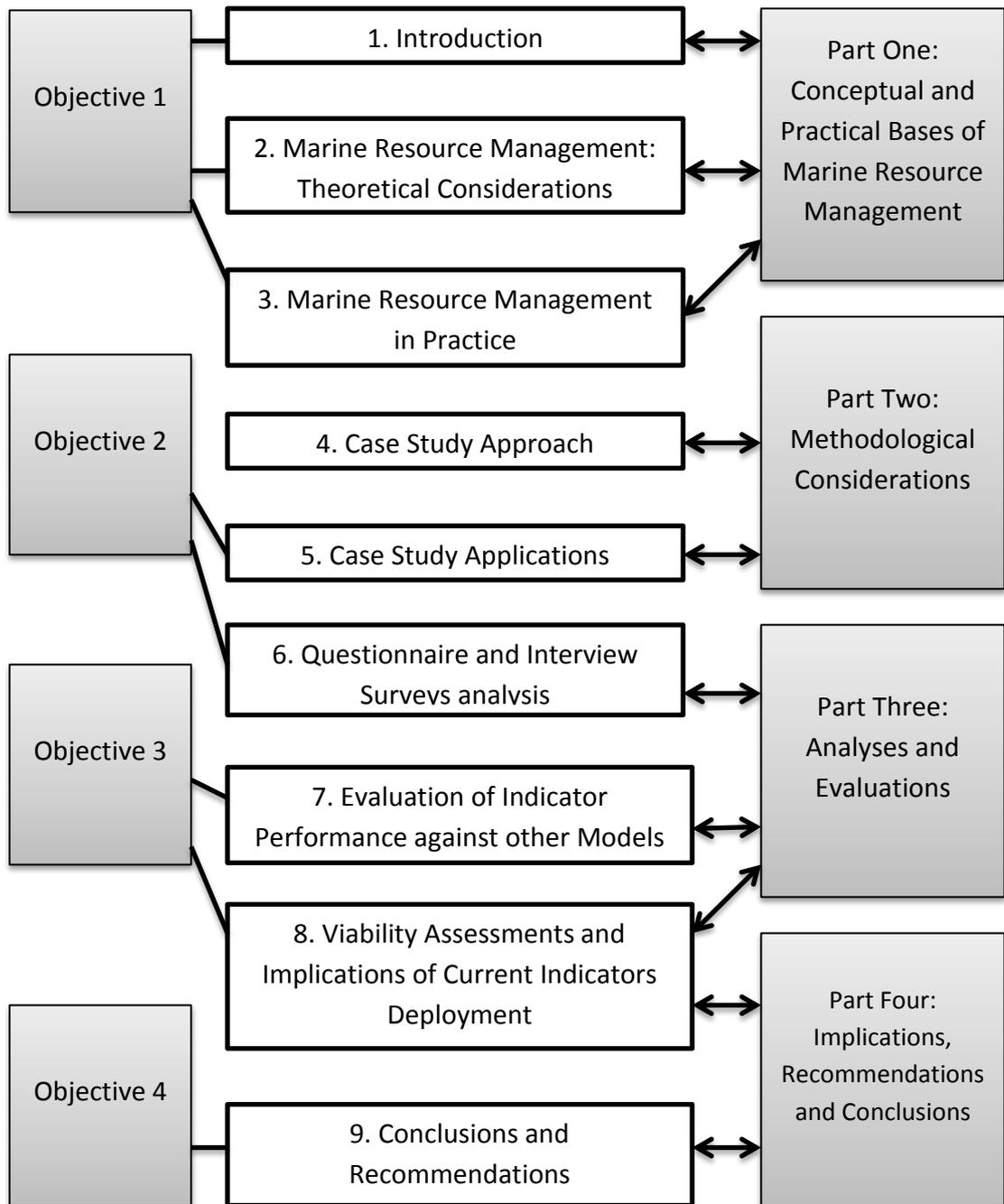


Figure 1.5-Structure of the thesis

(Source: Author's own)

### **1.5.1 Part One: The conceptual, theoretical and practical bases of marine resource management**

Chapter One introduces the research and contains an overview of the research area, historical perspective, the management structure for the JDZ resources as well as the aim and objectives of the research. This is in addition to providing the rationale for the research and laying out the structure and composition of the thesis.

Chapter Two provides the theoretical concepts underpinning marine resource management arrangements. It also highlights the processes and procedures as well as the institutional arrangements involved in their management by identifying the varying governance levels. It further expounds on marine ecosystems indicators in addition to detailing the development of the LME concept.

Chapter Three critically examines the marine resource management in practice in line with ecosystems based fisheries management overview. It equally evaluates the evolutionary trends in indicators deployment by highlighting their various levels and typologies culminating in the TWAP-LME indicators. Trends in their deployment across global locations would also be evaluated and the absence of specific sub-LME indicators for areas such as the research area will be equally established.

### **1.5.2 Part Two: Methodological considerations**

Chapter Four exemplifies the case study approach. Classes of case study approaches are examined and their merits and demerits highlighted. It also explains the survey conducted which was made up of face to face interviews and questionnaire administration to different categories of stakeholders across four different countries.

Chapter Five provides details of the survey administration and the participants as well as the modes of the administration involved. This was followed by a sectional and general summaries of the data obtained, how it was managed and the methods involved in its analysis. Evaluations of the indicators against their requirements as well as against their choice criteria will be illustrated. Details of how the outcomes

sent to the main stakeholder for feedback and comments were arrived at are highlighted as well.

### **1.5.3 Part Three: Analyses and evaluation**

Chapter Six provides the survey analyses based on the five main themes. Chapter Seven evaluates the indicator performances against other models by examining the current levels of JDZ fisheries management arrangements. It also evaluates the performances based on ideal indicator requirements for marine fisheries management and assessments. It then evaluates the current levels of indicator deployment for the JDZ fisheries against those ideal requirements. This is followed by developing practical steps involved in establishing a good system of indicator-based fisheries management regime. It finally provides the development of outcomes that were passed on to the resource managers for feedback and comments. (See Appendix Four).

### **1.5.4 Part Four: Implications, recommendations and conclusions**

Chapter Eight provides the viability assessments comprising of the discussions and the integration of feedback and comments from the JDA. Chapter Nine contains the conclusions and recommendations.

## **1.6 Overall contribution of the research**

The research contributes to providing detailed understanding of the feasibility of implementing the published TWAP-LME indicators in an area of sub-LME scale. It also provides key recommendations and insights as to how a set of indicators developed for the assessment of an LME area may be applied to examine marine living resource sustainability within an area not up to the size of an LME but within an identified LME.

The thesis contributes to knowledge within an area of research that has arguably not received the requisite attention; which is the call by the UN on the need to develop indicators and encourage capacities towards their adoption and employment, most especially within the developing countries.

It is also the first study that attempts to employ indicators to examine marine fishery sustainability of a shared stock under a joint development arrangement between two countries within the West African sub-region. The research also develops a set of recommendations that may be used to improve marine fishery sustainability of the JDZ fisheries using indicators of the changing state of marine ecosystems. Furthermore, the findings, results and conclusions from the research can be employed to fill the identified gap by contributing towards the development of specific sub-LME indicators for the management and assessment of shared marine fishery resources and their methodologies in view of their absence currently.

## **1.7 Summary**

Chapter One introduces the research by highlighting the overall location of the research area, challenges faced around the area, the uniqueness of the research area as well as the management structure of the JDZ as contained in sections 1.1 to 1.1.4.

Sections 1.2 to 1.2.3 introduce the rationale for the research, background and research context, the historical context as well as the aim and objectives of the research.

Section 1.3 and its components explains the overview of the research methodology, literature review and desktop study, case study approach, questionnaire and interview surveys, data management and analysis and the evaluation and selection of indicators respectively.

The scope and limitations of the research is clarified in Section 1.4 while the structure of the research is described in section 1.5. The composition of the thesis into its different parts is contained in sections 1.5.1 to 1.5.4 and the overall contribution of the research is disclosed in section 1.6.

Section 1.7 contains the summary of the chapter.

## **Chapter Two: Marine resource management: Theoretical considerations**

### **2.1 Introduction**

This chapter discusses the theoretical concepts underpinning the process of marine resource management. It will also examine the nature of the marine environment, the characteristics of transboundary marine resources, the issues encountered and the need for management.

Firstly, the concepts and processes of managing marine environmental resources as well as the institutional frameworks and the roles of the various institutions will be examined.

Secondly, the evolution of the law of the sea and the consequent apportionment of the ocean space into management units as well as marine spatial planning processes and procedures will be examined.

Thirdly, the evolution, theory and application of the Large Marine Ecosystem concept will be examined in addition to examining how Marine Protected Areas (MPA) are used to achieve ecosystem based fishery management.

Fourthly, the chapter will further elucidate the development of a Transboundary Waters Assessment Programme designed for the five water courses and the Transboundary Diagnostic Analysis conducted for the Gulf of Guinea. Finally, it will highlight the absence of specific sub-LME management and assessment initiatives. These issues will be examined so as to highlight the key theoretical concepts of marine resource management and put into perspective the intended focus of the research in the light of their relevance to the research area.

### **2.2 The theory of marine resource management**

Ocean or marine resource management has been defined as a system of management where various ocean activities such as fishing, dumping, navigation and mining along with the health of the ocean are considered collectively for management. This is deliberately done so as to achieve optimum utilisation of benefits to a given nation without jeopardising similar benefits from the same

resources by future generations (Smith, 1991; Couper, 1992; Peet, 1992; Smith, 1992).

The concept of marine, ocean or sea use management unlike other forms of management has to be viewed from three dimensions for it to be put into appropriate perspective. These are the transboundary nature of the marine environmental resources, the irrelevance of administrative boundaries of such environments and the complexity of marine ecosystems interactions, which must all be considered together in managing the ocean and its resources (Couper, 1992; Smith, 1992).

The process of marine resource management entails a series of actions or steps. It is generally believed (Smith, 1991; Smith, 1992; Couper, 1992; Peet, 1992; Cicin-Sain & Knecht, 1998) that the marine area and its resources cannot be managed in isolation from the coast; an area that contains a line from which the breadth of a territorial sea is measured. This is more so since what transpires at the coast naturally affects the marine environment. This is one of the reasons why the legal framework for the oceans' use which became consolidated with the advent of United Nations Convention on the Law of the Sea (UNCLOS) placed adjacent ocean areas under national jurisdictions of coastal States by defining their EEZs and continental shelves (Cicin-Sain & Knecht, 1998; Garcia & Hayashi, 2000).

### **2.2.1 Historical evolution of marine resource management**

Up until the beginning of the 14<sup>th</sup> century when the first division of the ocean was attempted by Spain and Portugal, which was subsequently challenged by the Dutch (Koers, 1973), ocean resources had always been seen as open-access resources with virtually no control over their uses. This may perhaps be as a result of the belief that the biological (living) and mineral (non-living) resources of the ocean are infinite and as such the freedom to exploit the oceans' resources was given to everyone that had the capability to explore (Koers, 1973; Sherman, 1986).

The existence of various marine resources within the ocean, inter alia fisheries, marine minerals and hydrocarbons entail further the necessity of the oceans' interactions with the coast. These interactions with their associated consequences

as depicted in Table 2.0, such as resource depletion, pollution, and desire to increase benefits, mineral exploitation and marine aquaculture triggered the need for integration in managing the marine and coastal areas' resources (Cicin-Sain & Knecht, 1998).

Table 2.0: Complexities of activities and consequences within the marine environment (Source: Author's own)

Activities	Consequences
Industrial fisheries	Resource depletion
Marine aquaculture	Resource depletion/Pollution
Seabed mineral extraction	Damage to coral reefs and sea grass beds
Hydrocarbon exploration	Marine pollution
Offshore minerals	Damage to aquatic habitats
Marine transportation	Invasive species/Pollution
Ocean research	Ecosystem perturbation
Marine recreation	Damage/perturbation to species assemblages

This is one of the reasons why managing marine resources has always been viewed as a complex task (Smith, 1992; Peet, 1992; Vallega, 1999) requiring equally complex interrelationships and cooperation between and among various disciplines in order to achieve sustainability (Stojanovic & Ballinger 2009; Knol, 2010; Stojanovic & Farmer, 2013).

Furthermore, marine ecosystems are considered to be among the most valuable and productive yet highly threatened systems in the world (Kay & Alder, 2005). As such, understanding them is of great significance (Knol, 2010) and managing them requires utmost caution in order to achieve and maintain their sustainability (Carneiro, 2011; Stojanovic & Farmer, 2013).

### 2.3 Characteristics of marine environmental resources

Marine environmental resources usually occur in the form of biological and mineral components in nature. The biological components include but are not limited to plants, fish and fisheries while the mineral components include hydrocarbons and marine minerals. This is in addition to other resources such as renewable energy

that are also found in the marine environment. While their occurrence can be said to be as a result of natural processes over time, control over their management has always been of particular interest to humankind and its quest for survival (Sherman, 1986; Garcia & Hayashi, 2000).

It is worthy of note however that ocean waters and the resources contained therein are among the most important marine environmental resources within the marine environment. Oceans' resources had up until the mid-20<sup>th</sup> century been under an open-access regime with the only exception recognised as a narrow strip of an area usually referred to as territorial sea (not exceeding three nautical miles then) (Garcia & Hayashi, 2000).

### 2.3.1 Understanding the issues within the marine environment

The marine environment may be described as an area made up of the oceans and their resources. It is a complex area requiring a conglomeration of expertise to manage due to the composition of both living and non-living resources co-habiting within the area. Over 75% of the earth surface is made up of oceans and these oceans account for more than 80% of the fish and fishery resources harvested by mankind (Garcia & Hayashi, 2000; Sherman, 2006; Sherman, 2014). This is in addition to the existence and exploration of several other minerals both in metallic and poly-metallic forms.

It has also been estimated that the global ocean resources as depicted in Table 2.1 contribute over \$12 trillion annually in ecosystem goods and services to the global economy in addition to being an important region of biological diversity (Sherman & Hoagland, 2005; Sherman, 2006; Sherman, 2014).

Table 2.1: Major marine sectors (Source: Author's own)

Examples of Major Marine Resources Contributors	
Oil and gas Exploration	Marine Minerals
Marine capture Fisheries	Waste Disposal
Aquaculture	Naval Activities
Renewable Energy	Education & Research
Marine Transportation	Settlements
Hydrothermal Development	Conservation
Marine Recreation	Communications

Despite this significant importance to the global economy as outlined above, the marine environment has been under equally significant and sustained threats and conflicts. These have been postulated to be as a result of issues such as conflicting uses, climate change and other associated issues (Sherman, 2014). They usually take the form of competition between and amongst various uses and are often recurrent in recent times due to the fact that most marine environmental spaces now fall under national jurisdictions as a result of coming into force of UNCLOS. This gives nation states powers to manage problems and at the same time increased the intensity of exploration in the marine environment (Uitto & Duda, 2002).

Similarly, marine environmental regions have been known to experience some documented cases of significant threats to the ocean environment and its resources. These threats include but are not limited to consistent over-fishing in the face of scientific warnings, fishing down food webs, destruction of habitat, and accelerated pollution loading—especially nitrogen export and oil production—which have resulted in significant degradation to coastal and marine ecosystems of both developed and undeveloped nations (Pauly et al., 1998; Duda & Sherman, 2002; Ukwe, Ibe & Sherman, 2006; Sherman et al., 2009; Carneiro, 2011).

These complexities which clearly pose a threat to this region of immense importance to both the global economy and human environmental well-being call for greater attention of both scientists and managers to be adequately equipped with the necessary knowledge and information (Sherman & Hoagland, 2005; Douvère & Ehler, 2009). This could arguably be the only way balanced and far reaching solutions can be provided in terms of managing this very complex environment that is home to numerous aquatic species and one of the strongest support bases for the global economy (Uitto & Duda, 2002; Stojanovic & Farmer, 2013).

Furthermore, the marine environmental resources are known to be in constant movement across boundaries thereby making them fluctuate across boundaries and therefore requiring transboundary management initiatives in managing them (Sherman et al., 2009; IOC-UNESCO, 2011).

### **2.3.2 The need for management of transboundary marine environmental resources**

While some transboundary marine environmental resources may not necessarily be among the living resources only, some hydrocarbons deposits, for example, have equally been found to be either spread across national boundaries or geological activity over time cause them to move over geological timescales (Lagoni, 1079). It is noteworthy that a significant percentage of these resources under single or shared jurisdiction are the living resources such as fish and fisheries and other marine mammals (Hayashi, 1995; Garcia & Hayashi, 2000; Uitto & Duda, 2002).

Consequently, the transboundary nature of these marine living resources posed some threats to the stability of the UNCLOS itself (Anderson, 1996; Orebech, Sigurjonsson & McDorman, 1998; Garcia & Hayashi, 2000). This was largely because of the issue of declining fish stocks due to overfishing and resource sharing being observed by competing adjacent states as a result of the continuous movements of resources. This brought to the fore the need to enact specific rules in order to govern such movements of fish stocks and to ultimately strengthen the UNCLOS (Balton, 1996; Juda, 1997).

The result was the '1995 Agreement on straddling fish stocks and highly migratory fish stocks' which was designed and adopted by coastal States in order to implement the principles of management inherent in the UNCLOS pertaining to these kinds of stocks. Among the key issues of the agreement was the delegation of authority to manage such stocks in Regional Fisheries Organisations (RFO) of coastal states (Orebech, Sigurjonsson & McDorman, 1998; UN, 2001).

The agreement became necessary as a result of the ambiguity, unpredictability and the absence of explicit implementation instruments in the provisions of Article 63 of the 1982 UNCLOS which covered the issues of obligation by the coastal states regarding the rights of high seas fishing concerns on straddling and highly migratory stocks (Juda, 1997; UN, 2001). These uncertainties led to over-exploitation reminiscent of the open-access or common pool resource era; as such the need for the agreement to respond to the various issues and conflicts relating to the highly

migratory and straddling fish stocks of areas under national jurisdiction and even the high seas (Anderson, 1996; Juda, 1997; Orebeck, Sigurjonsson & McDorman, 1998).

Following the delineation of ocean spaces and the advent of technology (Smith, 1991; Couper, 1992; Smith, 1992; Peet, 1992) the ocean space came to be characterised by conflicting pressures due to activities such as shipping, dredging, mineral extraction, fishing, offshore wind energy (Stojanovic & farmer, 2013). The need to comply with various national and international commitments to biodiversity conservation conversely exerted pressures on ocean resource uses. This brought about the need for sea use planning so as to balance the opposing demands on the oceans and their resources without compromising their ecosystem's health (Smith, 1992; Douvère & Ehler, 2009; Ban et al., 2014).

UNCLOS is the unified framework for managing all of marine resources of areas under national jurisdiction and the high seas by apportioning the global oceans into various units and placing the same under coastal states' jurisdictions in form of EEZs and the International Seabed Authority respectively (Garcia & Hayashi, 2000; Druel & Gjerde, 2013). It has been observed, however, that interactions between these resources (both living and non-living) may not necessarily be easily regulated due to conflicting and competing demands and uses (Druel & Gjerde, 2013; Gjerde, Curie, Wowk & Sack, 2013).

Marine minerals such as hydrocarbons, manganese nodules, gold and other seabed minerals may be very profitable to explore and their exploitation most often comes with its attendant consequences in the form of pollution and other alterations. This is usually detrimental to the wellbeing of other marine living resources such as fish and fishery resources which are transboundary in nature (Gjerde, Currie, Wowk & Sack, 2013; Suarez, Cicin-Sain, Wowk, Payet & Guldborg, 2014). This is buttressed by the fact that transboundary marine resources by their nature do not respect boundaries and are usually in a state of constant and often unpredictable movements whether living (over space and time) or non-living (over geological timescales) (Kearns, 1980; Juda, 1986; Higgins, 1991; Joyner, 2000).

This is one of the reasons why early divisions of the oceans and subsequent adoption of a unified framework for managing their resources (such as UNCLOS) were convened in the first place and their deliberations accepted by parties as a solution for managing these resources (Joyner, 2000; Garcia & Hayashi, 2000).

Managing these resources therefore became of paramount importance for obtaining optimum benefit and also the sustainability of the ocean environment itself (Gjerde, Currie, Wowk & Sack, 2013; Suarez, Cicin-Sain, Wowk, Payet & Guldborg, 2014).

## **2.4 Managing marine living resources**

Conflicts within the marine environment are intensifying (Gjerde, Currie, Wowk & Sack, 2013), coupled with the fact that the sustainability of the ocean's living resources is increasingly faced with significant challenges to the point of posing a real threat to global food security (Suarez, Cicin-Sain, Wowk, Payet & Guldborg, 2014) and considering the enormous contribution of marine living resources to global economy (Sherman, 2014). The need to properly manage these resources now becomes of paramount importance.

Furthermore, on a geographical scale it has also been found that at the EEZ level, there have been consistently sustained fisheries losses globally since the advent of industrialized fishing in the 1950s (Srinivasan, Watson & Sumaila, 2012). These losses were however observed to be masked by global trade within the whole of world's oceans through the manipulation of reported landings (Srinivasan, Watson & Sumaila, 2012).

Historically, there have always been less concerted efforts to manage marine living resources because of the belief or assumption that ocean resources were considered open access. This was until the start of the nineteenth century when some nation states realised the need for the assignment of property rights on these resources (Sherman, 1986; Alexander, 1993; Garcia & Hayashi, 2000).

The formation of the International Council for Exploration of the Sea (ICES) in 1901 was as a result of the realisation that the continuous provisioning service of the

global oceans of commercially desirable fishery stocks was finite rather than infinite as previously held. This brought about the establishment of joint biological and hydrographical research on marine living resources internationally in the North Atlantic, the North Sea and the Baltic Sea (Sherman, 1986).

This led to the conduct of several other studies cutting across various institutional, national and international scales into coastal and marine activities and subsequently the need to apportion control over coastal and marine resources (Sherman, 1986). It is also one of the reasons that the United Nations held several conferences and enacted legislations regarding the resources of the seas and its uses as illustrated in Figure 2.5 (Smith, 1991; Smith, 1992; Garcia & Hayashi, 2000).

As the marine living resources became threatened and propriety started to emerge, assertive interests in the management of oceans' resources assumed a stronger dimension when fishery stocks started declining to the extent of threatening their provisioning nature for the majority of coastal states. It is as a result of this that within a short span of time the impact became widespread and individual states acknowledged the danger such declines posed (Couper, 1992; Longhurst, 2007).

Generally, on the global scale, there exist some uncertainties however, in the valuation of fish stocks with some researchers claiming that the entire fish stocks might be depleted going by the current level of catches (Longhurst, 2007; Sumaila et al., 2007; Sumaila, 2010). There is also a common perception among the general public that fisheries in many seas have collapsed as a result of over fishing. It is generally assumed that the situation is not improving while dissent usually comes from those sectors of the fishing industry that are out to avoid additional catch restrictions (Longhurst, 2007; Nunan, 2007; Carneiro, 2011).

From the foregoing, it is deduced that one way of resolving such challenges is arguably by identifying and recognising such habitats as well as placing them under or within marine spatially planned zones so as to improve their assessments and lead to better management.

## **2.5 Marine spatial planning**

Marine spatial planning (MSP) has been defined as a way of improving decision making aimed at delivering an ecosystem-based approach to managing human activities within the marine environment (Pomeroy & Douvère, 2008). It has also been postulated as a planning process which enables integrated, progressive, and sustainable decision making on the human uses of the sea and its resources (Ehler & Douvère, 2007; Pomeroy & Douvère, 2008). It is a way of envisaging or forecasting scenarios based on clear and concise planning from the onset rather than being a sort of remedy to a problem or threat.

As such, ecosystem-based MSP aims to optimize the benefits accruable to humans as well as other living organisms from the ecological goods and services that the oceans provide. It seeks to provide a mechanism towards achieving a form of consensus between and among all competing uses and users operating within the marine environment (Ehler & Douvère, 2007; Gilliland & Laffoley, 2008; Pomeroy & Douvère, 2008). Therefore MSP views the marine environment as an entity comprising of both natural and human components intertwined with linkages between and amongst its various elements.

### **2.5.1 The process of marine spatial planning**

MSP has been recognised as an essential tool for ensuring ecosystem based management through the selective adoption of the processes inherent in land use planning. There are several basic steps, techniques and processes involved in initiating the process of establishing an appropriate MSP regime (Gilliland & Laffoley, 2008; MSPP, 2006). As such a framework becomes a necessary and logical part of such a design, just as is found on land.

From the literature, there exist a number of key elements to MSP (Ehler & Douvère, 2007; Gilliland & Laffoley, 2008; Katsanevakis et al., 2011) some of which are explained in turn theoretically, with some key examples and basic steps necessary for their applications in order to underpin their origins.

These key elements and steps would predominantly be based on experiences drawn from the UK and the European Union (EU) as expounded in the works of

some scholars such as Ehler & Douvère, (2007); Gilliland & Laffoley, (2008) and Pomeroy & Douvère, (2008). The key elements may include decision, quantification of the cost, gauging the stakeholder support, establishing the purpose, establishing the guiding principles, defining the geographical scope, determining the hierarchy and appropriate steps and finally delineating its boundary (Gilliland & Laffoley, 2008).

It has also been acknowledged that there is no singularly acceptable time frame an MSP should take although most take not less than ten years while others take even more (Gilliland & Laffoley, 2008). An example of a typical time scale is presented in Figure 2.0 from the UK perspective as suggested by a consortium of consultants commissioned by the Department of the Environment, Food and Rural Affairs (DEFRA) in 2006:

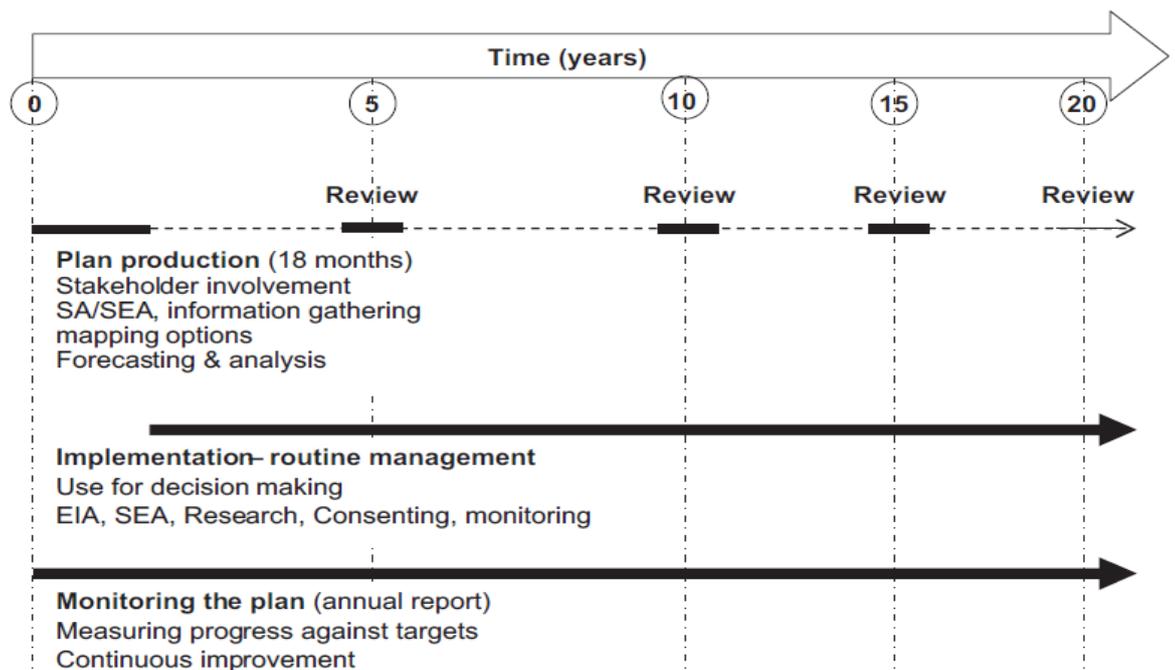


Figure 2.0 MSP timescale suggested programme (Source: MSPP, 2006)

This is followed by the key components required for setting up a basic MSP as presented by Gilliland & Laffoley (2008) denoting the basic steps necessary for the MSP process. These are setting clear objectives, spatial data, planning and guidance as well as identification of priorities and are as visualised in Figure 2.1

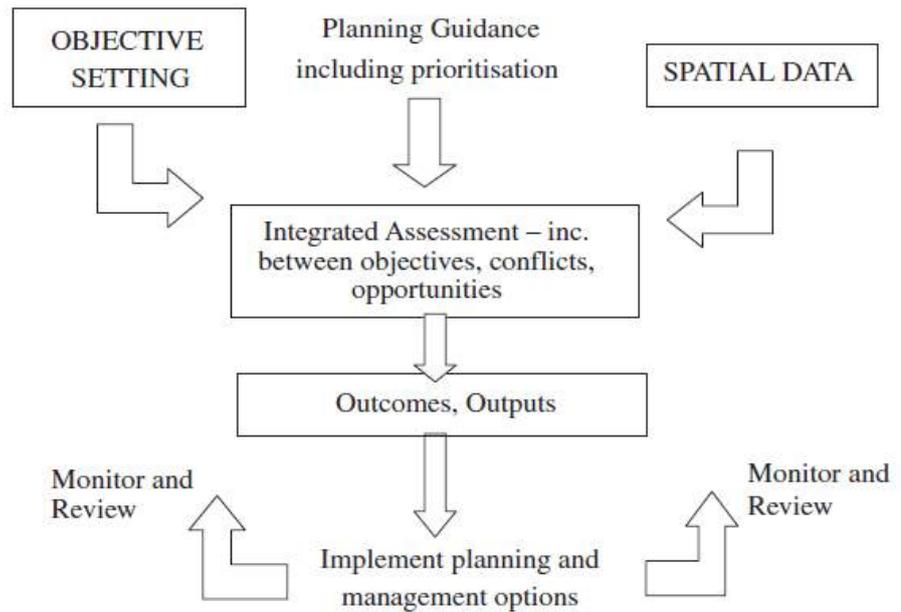


Figure 2.1- Basic steps in the MSP process (Source: Gilliland & Laffoley, 2008)

The processes and procedures highlighted must incorporate stakeholders at each point of the process as the success or optimal performance of any MSP depends on adequate stakeholder engagement (Gilliland & Laffoley, 2008). This is very important especially in the determination of goals and objectives, identification of issues, evaluation of plans as well as in the examination of the plans so as to ensure sufficient stakeholder engagement and ultimately acceptability as visualised in Figure 2.2 based on the Irish Sea regional marine plan:

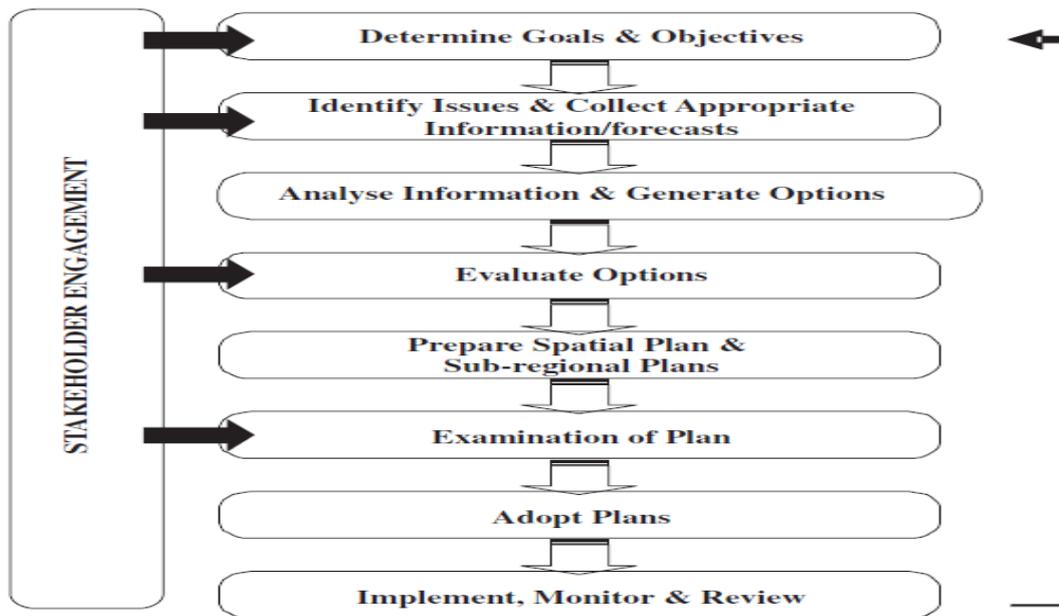


Figure 2.2- Plan production process and stakeholder engagement (Source: MSPP, 2006)

The following section highlights how MPAs are used to achieve ecosystem based fishery management by emphasising its conservation and preservation characteristics.

## 2.6 The use of Marine Protected Areas (MPAs) to achieve EBFM

Some scholars such as Douvere (2008) and Pomeroy & Douvere (2008) concluded that for a marine spatial plan to be effective, there is a need for clear and precise definitions of concepts such as ‘integrated management’, ‘ocean zoning’ and ‘spatial management’. Douvere (2008) further attributed the current lack of wider MSP adoption in policy formulation and decision-making processes to these ambiguities despite its acceptance by academia and some implementations across some EU countries.

However, as embedded within the ecosystem based fisheries management principles; fisheries are not meant to alter or destroy an ecosystem state rather they are to enhance its preservation and conservation (Douvere, 2008; Tallis et al., 2010).

As such the idea of setting or establishing an MPA can always be traced to its ecosystem's preservation and conservation characteristics. This has been recognised by Foley et al., (2010) as an approach that considers the environment as a whole rather than as a single unit. This includes all the interrelationships, interdependencies and interconnectedness of all species including human beings, issues and provisioning services of the ecosystems combined (Foley et al., 2010).

MPAs are usually set up or used in order to conserve marine biodiversity, for coastal tourism development, protection and management of marine living resources such as fish and fisheries. They make assessments of species assemblages in terms of a range of management choices easier because of assigning some values to the biophysical and geochemical features of the marine environment (Katsanevakis et al., 2011).

### **2.6.1 Characteristics of MPAs**

From the foregoing, it is inarguable that for an MPA to achieve its objectives and serve the purpose for which it was created in the first place, the need for sustained feedback is essential and is recognised as the underlying factor in determining indicators for ensuring an adaptive management of an MPA (Pomeroy, Watson, Parks & Cid, 2005).

As such, the main characteristics of a MPA have been found to be the preservation and conservation of the ecosystem and of the resources they are set up to regulate such as fisheries, corals and tourism as well as other vast arrays of marine resources (Pomeroy, Watson, Parks & Cid, 2005).

As MPAs are expected to operate under divergent biophysical, socioeconomic and institutional situations around the world, a consortium of international institutions comprising of the International Union of the Conservation of Nature (IUCN), the World Bank, Intergovernmental Oceanographic Commission (IOC) and NOAA developed a guidebook of methodology. This was developed to make the selection and measurement of the indicators of MPA management effective and to serve as a yardstick for its assessment (Pomeroy, Watson, Parks Cid, 2005; Douvere, 2008).

It is this methodology that will be expected to determine the characteristics of an appropriate MPA and also highlight its optimum function. The guidebook consists of a four-part process namely; selecting the appropriate indicators, planning and preparation for the evaluation, collecting and analysing the data for the selected indicators, as well as communicating and implementing the evaluation of results in order to adapt to the MPA's management (Pomeroy, Watson, Parks & Cid, 2005).

## **2.7 Ecosystem based management**

The term 'ecosystem' was first introduced and defined by Tansley (1935) who defined it as a 'biotic assemblage and its associated physical environment in a specific space'. Pg. 299

The increasing pressure on the coastal areas as a result of population increase in the late twentieth century, with about two thirds of the world's population living within 60 miles of the coastline and growing, coupled with climate change and sea level rise have become a critical issue in the decision making cycle and communities at large for coastal and marine resources management (Vallega, 1999).

Coastal and marine ecosystems are considered to be among the most valuable and productive yet highly threatened systems in the world (Kay & Alder, 2005). While their management is always tied to each other as any impact on the former ultimately affects the latter.

Ecosystem-based management is and has always been widely discussed in the context of fisheries management in the EU. While one of the main frameworks of EU fisheries management backbone is under review; the Common Fisheries Policy (CFP), it is noteworthy however that ecosystem based fisheries management approaches have been adopted in the EU forty years ago (Aanesen, Armstrong & Hoof, 2012). Historically, the institutional frameworks governing European seas and oceans became highly developed within the last four decades. However, only recently has focus actually been directed towards more integration thereby resulting in embedding ecosystems based approaches in both stakeholders and policy formulation perspectives. This is in spite of having adopted policies such as

the Common Fisheries Policy (CFP) and the Marine Strategy Framework Directive (MSFD) in place for quite some time now (Aanesen, Armstrong & Hoof, 2012).

This is further evidenced in the recent unification of policies such as the CFP and MSFD into the Maritime Policy (MP) in 2009; which emerged as the preferred centrepiece for both the marine and maritime management in the EU (Aanesen, Armstrong & Hoof, 2012).

The MP was designed to be all encompassing by emphasising both the economic benefits and sustainability even though the CFP and MSFD also possess a clear focus in support of adaptive management (Aanesen, Armstrong & Hoof, 2012).

### **2.7.1 The need for ecosystem based approach to fisheries management**

As binding international instruments that are of significant relevance to ecosystem based approaches to fisheries management gained prominence since the last four decades, it became increasingly convenient and preferable for nation states to adopt the ecosystem based concept both for the sustainability of their fisheries resources as well as for their ratification of many such treaties. Either way national interests are usually however served in line with their goal of attaining sustainability (Garcia & Cochrane, 2005; Aanesen, Armstrong & Hoof, 2012).

International conventions such as the 1971 RAMSAR Convention on Wetlands, the 1973 Convention on International Trade in Endangered Species (CITES), the 1982 Law of the Sea Convention which came into force in 1994, the 1992 Convention on Biological Diversity (CBD) and the 1995 Fish Stocks Agreement all played a vital role in getting countries committed to appreciating the need to adopt ecosystem based approaches to marine resources management including fisheries management (Garcia & Cochrane, 2005; Christie et al., 2007).

As such, the need for an ecosystem approach became more pertinent than ever most especially when the shortcomings faced by conservation and management of natural resources over time are considered. These shortcomings are single sectoral

considerations and the negation of the value of ecosystems services in management and decision making processes (Tallis et al., 2010).

### **2.7.2 Managing marine resources through ecosystem based management perspective**

As a result of the realisation of the failure of species-specific and sectoral approaches to achieve sustainability in marine resource management as embedded within the traditional methods of management (Sherman & Duda, 1999; Vallega, 1999; Wang, 2004; Sherman et al., 2009), the United Nations through its intervention institutions such as the Global Environment Facility (GEF), UNESCO and a significant consortium of academics adopted the concept of ecosystem based management as a preferred approach in managing marine resources of the oceans. They equally promoted the same for their interventions in the assessment of the marine environmental resources (Sherman et al., 2009; Sherman, 2014).

The move to ecosystem based management has also arisen from the identified pressures on the coastal and marine environment as observed earlier by Vallega (1999) in Section 2.7. The evolution of the concept of division of the ocean space under UNCLOS and the emergence of MSP over the last decade collectively heralded an important step towards incorporating ecosystem based component of sea use management (Douvere, 2008).

While no consensus exists as to the exact definition of ecosystem based management, various scholars (Slocombe, 1993; Sherman & Duda, 1999; Vallega, 1999; Wang, 2004; Arkema, Abramson & Dewsbury, 2006; Murawski, 2007; Ruckelshaus et al., 2008; Sherman et al., 2009; Fletcher et al., 2010; Curtin & Prellezo, 2010) defined it at different periods of time in various circumstances.

What is agreed however among scholars is that an ecosystem-based management concept denotes a paradigm shift away from a sector by sector approach. It requires a collective understanding of marine ecosystems together with its resources and of the transboundary nature of water governance, fisheries, climate change, water pollution and other environmental perturbations as depicted in Figure 2.2 modified from Sherman (2006).

Table 2.2- Paradigm shift

(Source: Sherman, 2006)

FROM	TO
Individual species	Ecosystems
Small spatial scale	Multiple scales
Short-term perspective	Long-term perspective
Humans: independent of ecosystems	Humans: integral part of ecosystems
Management divorced from research	Adaptive management
Managing commodities	Sustaining production potential for goods and services

### 2.7.3 Defining the ecosystem based fishery management

As noted earlier and substantiated by several other scholars (Slocombe, 1993; Sherman & Duda, 1999; Vallega, 1999; Wang, 2004; Arkema, Abramson & Dewsbury, 2006; Murawski, 2007; Ruckelshaus et al., 2008; Sherman et al., 2009; Fletcher et al., 2010; Curtin & Prellezo, 2010) because of the use and deployment of the term ‘ecosystem’ by a vast array of users and contexts, a single definition of ecosystem based management may not be possible.

The FAO defined an Ecosystem Approach to Fisheries (EAF) as a system that strives to balance diverse societal objectives by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and applying an integrated approach to fisheries within ecologically meaningful boundaries as illustrated in Figure 2.3 (FAO, 1996; Garcia et al., 2003).

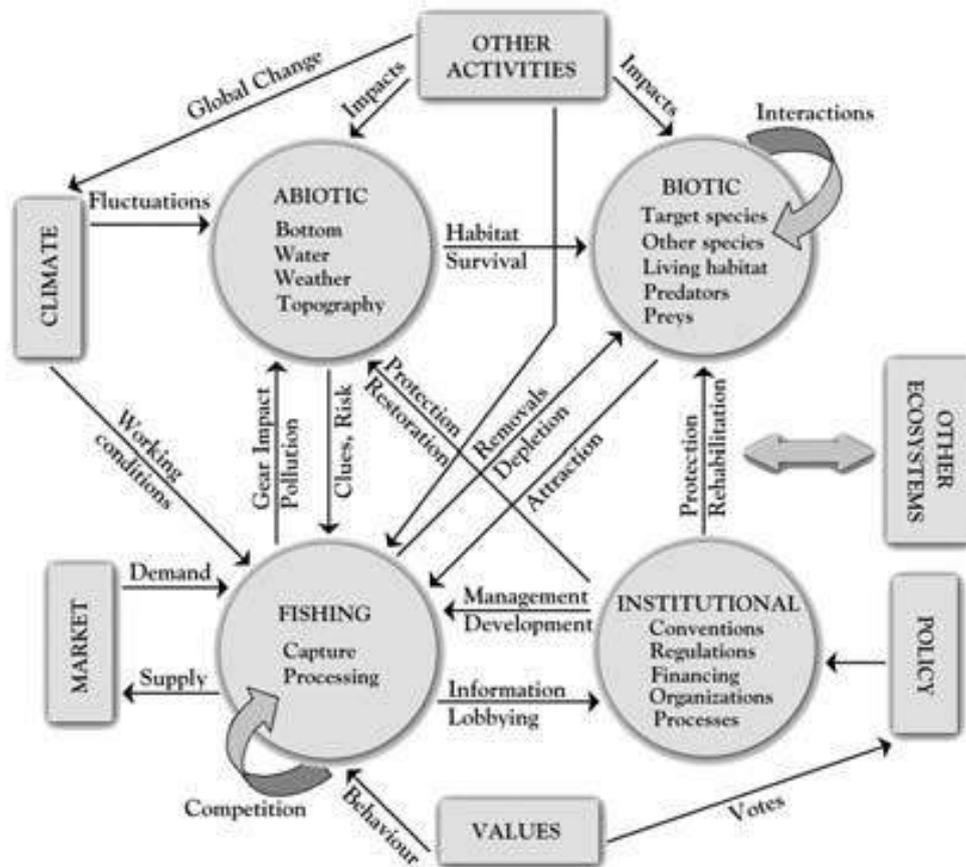


Figure 2.3–Simplified ecosystem components diagram modified from (Garcia et al., 2003).

When ecosystem-based management is applied principally to manage fisheries, it becomes commonly referred to as ecosystem-based fisheries management. This connotation is justified by the dominant nature of fish and fisheries within the marine living resources both in terms biodiversity and abundance (Sherman & Duda, 1999; Christie et al., 2007).

This is more so given the fact that the ecosystem management and fishery management concepts have almost always emerged simultaneously (Garcia et al., 2003) and the need to sustainably manage the latter may have generated the desire and the subsequent adoption of the former and its varied paradigms in Table 2.3

Table 2.3- Schematic comparison between fisheries and ecosystem management  
(Modified from Garcia et al., 2003)

Criteria		Fisheries management	Ecosystem management
<b>Paradigm</b>		Sector-based. Vertically integrated. Focusing on target resource and people.	Area-based. Holistic. Loosely cross-sectoral. Focusing on habitats and ecosystem integrity.
<b>Governance</b>	<b>Objectives</b>	Not always coherent or transparent. "Optimal" system output. Social peace.	A desired state of the ecosystem (health, integrity).
	<b>Scientific input</b>	Formalized (particularly in regional commissions). Variable impact.	Less formalized. Less operational. Often insufficient. Stronger role of advocacy science.
	<b>Decision-making</b>	Most often top-down. Strongly influenced by industry lobbying. Growing role of environmental NGOs.	Highly variable. Often more participative. Strongly influenced by environmental lobbies. Stronger use of tribunals.
	<b>Role of the media</b>	Historically limited. Growing as fisheries crisis spreads.	Stronger use of the media.
	<b>Regional and global institutions</b>	Central role of the Food and Agriculture Organization of the UN and regional fishery bodies.	Central role of United Nations Environment Programme (UNEP) and the Regional Seas Conventions.
<b>Geographical basis</b>		A process of overlapping and cascading subdivision of the oceans for allocation of resources and responsibilities.	A progressive consideration of larger-scale ecosystems for more comprehensive management, e.g. from specific areas to entire coastal zones and Large Marine Ecosystems (LME).
<b>Stakeholder and political base</b>		Narrow. Essentially fishery stakeholders. Progressively opening to other interests.	Much broader. Society-wide. Often with support from recreational and small-scale fisheries.
<b>Global instruments</b>		1982 Law of the Sea Convention, UN Fish Stock Agreement and FAO Code of Conduct.	Ramsar Convention, UN Conference on Environment and Development and 1992 Agenda 21, Convention on Biological Diversity and Jakarta Mandate.
<b>Measures</b>		Regulation of human activity inputs (gear, effort, capacity) or output (removals, quotas) and trade.	Protection of specified areas and habitats, including limitation or exclusion of extractive human activities. Total or partial ban of some human activities.

However, institutional and governance challenges have always been identified as needing continuous and sustained monitoring and evaluation for an ecosystem based fishery management initiative to succeed. This is more so in many tropical contexts as evidenced from Christie et al., (2007). A generalised consensus on the definition of the concept in terms of its application to fisheries science and management could be generally taken as the fisheries management that appreciates the interconnectedness, interdependence and interrelationships between the biotic and abiotic components of the ecosystem in relation to how

human expectations of the provisioning services of the marine ecosystem could be met sustainably (Slocombe, 1993; Sherman & Duda, 1999; Arkema et al., 2006; Murawski, 2007; Ruckelshaus et al., 2008; Sherman et al., 2009; Fletcher et al., 2010; Curtin & Prellezo, 2010).

#### **2.7.4 The concept of ecosystem based fishery management**

The concept of Ecosystem-Based Management (EBM) evolved during the 1970s as a response to two main properties of natural systems. These are based on the premise that (1) exploitation of natural resources possesses high interconnectedness which can impact significantly on their surrounding environment either directly or indirectly immediately or at the long term. (2) That the exploitation has the tendency to impact on other resources as well as aspects and species of other resources (utilized or utilized) dependent on the ecosystem (Ward et al., 2002).

While some scholars posited that the Ecosystem Approach to Fisheries (EAF) emerged at the dawn of the millennium as an alternative approach to single species fishery management (Garcia & Cochrane, 2005; Smith et al., 2007), others were of the view that the concept of ecosystem based management has been around as early as the 1960s (Czech, 1996; Czech & Krausman, 1997) and emerged strongly in the 1970s with the convening of the 1972 Stockholm Conference on the Human Environment.

The 1992 Conference on Environment and Development (UNCED) and Convention on Biological Diversity further strengthened the concept, while the FAO adopted it in 2002 for a number of reasons which include but are not limited to the reticence expressed by the Reykjavik Conference in terms of its compatibility with EBFM definitions (Ward et al., 2002; FAO, 2003; Garcia et al., 2003) as visualised Table 2.4

Table 2.4- Chronological development of the Ecosystem concept  
(Source: Author's own)

Evolution of the EBM concept	Year
Emergence	1960s
Strong Emergence in Academic Community	1970s
Acknowledgement by Academic Community	1980s
Adoption by Int. Community through various conventions	1980s/ 1990s
Adoption by Academics	1990s/ 2000
Adoption by Nation States	1990s/ 2000
Unified Adoption	2000
In Practice	Present Day

The idea of adopting an ecosystem based management approach for fisheries gained prominence in the 1990s. This led to adopting a revised focus to advance scientific understanding of the whole system and to enhance decision-making processes for effective and sustainable management (Fletcher, Shaw, Metcalf & Gaughan, 2010).

In the context of fisheries, these concepts sometimes referred to as principles are comprised of a number of interrelated guiding requirements. They include avoiding overfishing, ensuring reversibility and rebuilding, minimizing fisheries impact, considering species interactions, ensuring compatibility, applying the precautionary approach, improving human well-being and equity, allocating user rights, promoting sectoral integration, broadening stakeholders' participation and maintaining ecosystem integrity (FAO, 2003).

These concepts are also equally embedded within various protocols and conventions as itemised in Table 2.5

Table 2.5 showing how ecosystem concepts are embedded within instruments/conventions (Source: Author's own)

Guiding Concepts	Supporting Instruments/ Conventions
Avoiding Overfishing	1982 UNCLOS(Article 61.2) and 1980 CCALMR
Ensuring Reversibility and Rebuilding	1982 UNCLOS(Article 62.3) and 1980 CCALMR
Minimizing Fisheries Impact	Article 5f of Food Standards Agency(FSA)
Considering Species Interactions	1982 UNCLOS(Article 62.3)
Ensuring Compatibility	1995 Straddling Fish Stock Agreement/FSA Article 6.2
Applying Precautionary Approach	UNCED Declaration (Principle 15)
Improving Human Well-Being	Several Instruments such as Agenda 21
Allocating User Rights	1995 FAO Code of Conduct for Responsible Fisheries
Promoting Sectoral Integration	FAO Code of Conduct/ WWF Guidelines
Broadening Stakeholders' Participation	FAO Code of Conduct/ Agenda 21
Maintaining Ecosystem Integrity	Convention on Biological Diversity

Achieving sustainability has been identified as the main goal of any fishery management scheme, but it has almost always proven elusive. As a result of this, there has been near consensus globally over the last decade that what is needed is an ecosystem based fisheries management to stem the tide (Rudd, 2004; Fletcher, Shaw, Metcalf & Gaughan, 2010).

As observed earlier in Sections 2.7.2 and 2.7.3 by scholars such as Slocombe (1993), Sherman & Duda (1999), and Christy et al. (2007) ecosystems must be considered holistically as a combination of complex adaptive systems capable of indicating changes in ecosystem state at higher levels as a result of alteration of processes and procedures occurring at lower levels. This will ensure that marine ecosystem based management is better understood (Curtin & Prellezo, 2010).

However, some scholars such as Arkema et al., (2006) are of the view that a huge disconnect exists between ecosystem based management's definition and its application by a significant number of scientists on the global scale most especially

in their incorporation of the term or in the adoption for management plans. This may have taken precedence from inconsistencies in its definition between and among scientists, policy makers and managers over time. These inconsistencies are one of the reasons for the evolution of ocean management initiatives over time.

## **2.8 Evolution of the concept of management regarding marine resources**

The concept of managing marine resources generally has emerged strongly from the beginning of the 14<sup>th</sup> century based on the realisation of the need to apportion control over the ocean resources (Kurien, 1998) and later as a result of the desire to harmonise various emerging activities such as fishing, navigation, dumping, mining and military uses with maintaining the health of the ocean (Smith, 1991; Couper, 1992; Smith, 1992) for the common benefits of mankind.

As various uses of the ocean emerge along with their associated conflicts (Smith, 1992; Cicin-Sain & Knecht, 1998; Garcia & Hayashi, 2000), the need to properly manage the ocean resources and assign control or ocean property rights by adjacent coastal nations became stronger bringing alongside multiple challenges and agitations as a result of industrialisation (Koers, 1973; Garcia & Hayashi, 2000).

The challenges brought about by the commencement of industrialisation and subsequent introduction of steam power during the latter part of the 19<sup>th</sup> century which strengthened nation states ability to exploit the oceans led to the first UN conference on the Law of the Sea in 1958 (Koers, 1973; Smith, 1991; Smith, 1992; Garcia & Hayashi, 2000). This was convened primarily to manage the conflicting sea uses and ocean resources. While others believed the conference was as a result of apportioning control for warfare at sea and that negotiations for some control over the sea and its resources predated even the Hague Conventions of 1899 and 1907 (Rosenne, 1996).

Failure to arrive at a consensus led to the convening of a second conference in 1960 in order to address the identified areas of dispute, but this was also to be aborted as the parties could not reach a common position (Garcia & Hayashi, 2000; Joyner, 2000).

In the 1970s, growing concerns over the offshore fisheries, continental shelf, deep seabed resources and rights of innocent passage led to the convening of the third conference that spanned from 1973 to 1982 (Joyner, 2000). This is in addition to several other competing and sometimes conflicting uses of the ocean space depicted in Figure 2.4

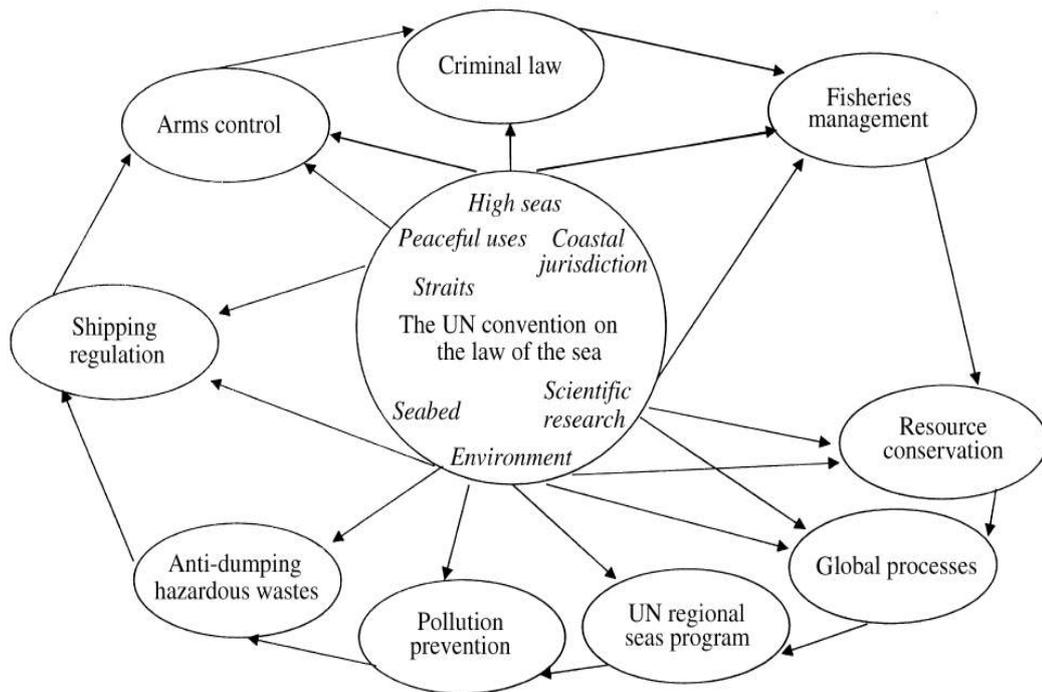


Figure 2.4-Interpretation of UNCLOS 3 regime taken from (Joyner, 2000)

### 2.8.1 Historical evolution of the Law of the Sea

The third United Nations Convention on the Law of the Sea (UNCLOS) conference which came into force in 1994 ushered in a global comprehensive framework for the management of marine resources. Here, it was agreed for coastal states to extend their jurisdictions seaward from 12 or 13 Nautical miles to 200 Nautical miles depending on the State making the claim as different nations have different claims. This extension is referred to as the Exclusive Economic Zone (EEZ). The main objective of establishing the EEZ is to enhance the conservation and sustainable development of global marine resources (Lauck et al., 1998; Garcia & Hayashi, 2000). Figure 2.5 illustrates the evolution of the UNCLOS regime depicting the various conventions in time up to its adoption in 1994 when it came into effect.

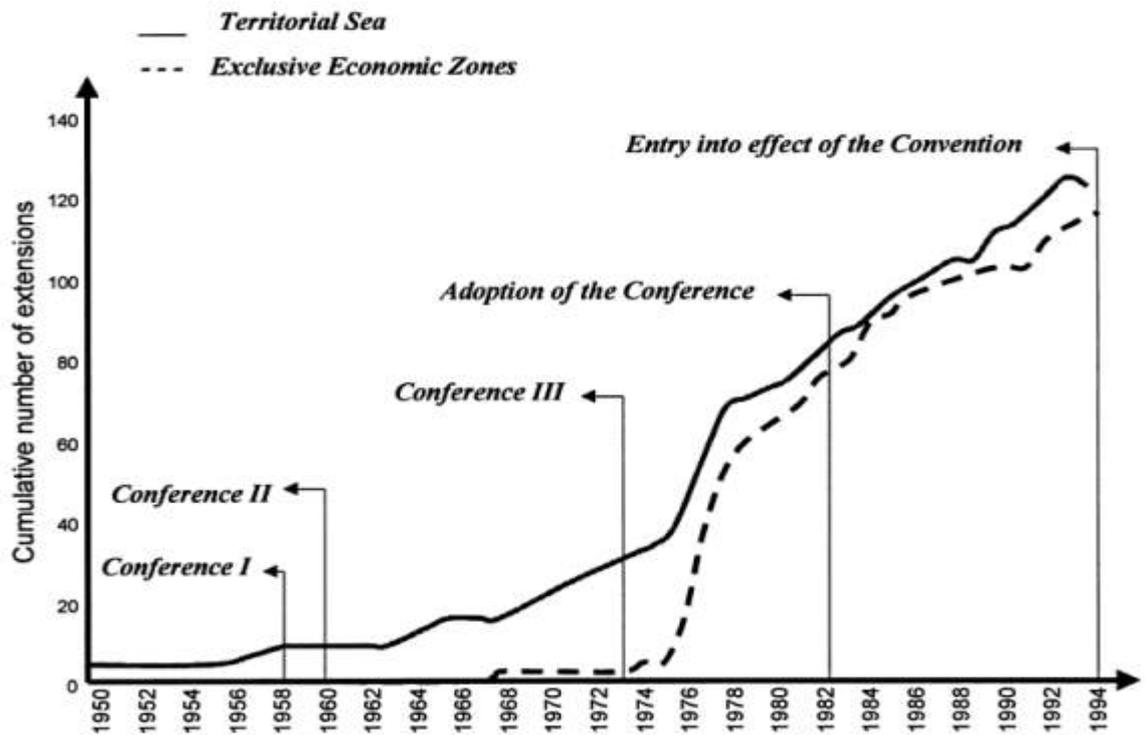


Figure 2.5- Historical evolution of UNCLOS (Source: Garcia & Hayashi, 2000)

Apart from establishing a comprehensive legal regime for the global oceans and high seas through the provision of rules governing the use of oceans and its resources; UNCLOS 1982 also delineated the marine environment into 'zones' that are both within and beyond national jurisdictions. These zones are the internal waters, archipelagic waters, the territorial sea, the contiguous zone, the continental shelf and the EEZ. All of these zones are measured from the baseline extending along the coast (Kimball, 2005; Gjerde et al., 2013).

The internal waters are enclosed areas landwards to a baseline and are usually not different from the territorial sea for purposes of fisheries as both of them are placed under a coastal state's sovereignty. Archipelagic waters are the waters whose baseline joins all the outermost points of the islands as well as drying reefs of the Archipelago State (Garcia & Hayashi, 2000; Kimball, 2005). The contiguous zone is an area which may not extend beyond 24 nautical miles from the baselines from which the breadth of the territorial sea is measured. It is a zone where a coastal State asserts its control in order to prevent and punish infringements over its customs, immigration and sanitary laws. The continental shelf is made up of the

seabed and the subsoil of the marine area beyond the territorial sea throughout the natural prolongation of a coastal state's land boundary to the outer edge of its continental margin or to a distance of 200 nautical miles from its baselines from which the breadth of the territorial sea is measured if the outer edge of the continental margin does not extend up to that (Garcia & Hayashi, 2000; Kimball, 2005). The EEZ is an area which is beyond the territorial sea in which a coastal state enjoys rights and jurisdictions as granted by UNCLOS and extends up to 200 nautical miles from baselines (Articles 8(4), 47(6), 51, 56, 58, 78, UN, 2001).

The 1982 conference also covered the development and sustainable management of non-living marine resources. These include the conventional oil and gas within the EEZ, the poly-metallic nodules (manganese, nickel, cobalt and copper) found on the deep sea floor as well as other more exotic metals sources such as poly metallic sulphides that are usually found around hydrothermal vents in the deep sea bed. It also covered cobalt-rich crusts usually found as pavements on the sea floor which are also very rich in zinc, gold, copper and silver (Joyner, 2000; Garcia & Hayashi, 2000; Gjerde et al., 2013).

The mining and control of deep seabed manganese nodules was one of the most important issues during the third conference negotiations which prompted the creation of a special mining regime in part XI of the 1982 convention (UN, 2001). As such, the deep seabed legal status became enshrined in Article 136 which proclaimed it as a 'common heritage of mankind', with its exploration and exploitation being undertaken by the International Seabed Authority (ISA); also created in the same part XI and modified by the 1994 Implementation Agreement. The Agreement, which significantly amended certain portions of the convention, is to be interpreted alongside the convention as a single instrument with a proviso that where inconsistencies emerge, the provision of the Agreement shall prevail (Joyner, 2000; UN, 2001; Druel & Gjerde, 2013; Suarez et al., 2014).

### **2.8.2 The division of the ocean space into management units**

UNCLOS delineated maritime waters into various functional areas, namely; Internal waters, Archipelagic waters, Contiguous zone, Territorial waters, Continental shelf,

EEZ and the High seas and placed them under the sovereignty of the coastal state and the ISA respectively. The coastal state has the following rights and duties with respect to its EEZ as enshrined in Articles 61 and 62:-

(a) Determining the total allowable catch (TAC) of the marine living resources. (b) Taking the proper conservation and management measures to ensure sustainable exploitation in order to maintain and restore populations of harvested species at levels that can produce maximum sustainable yield (MSY) determined by relevant environmental and economic factors. (c) Determining its capacity to harvest the living resources as well as authorizing other states to harvest the surplus of the TAC through agreements and other arrangements. (d) Disseminating and exchanging on a regular basis, through competent international organisations, available scientific information, catch and fishing effort statistics and other data relevant to the conservation of living marine resources by giving due notice of laws and regulations it adopts with regard to conservation and management' (Garcia & Hayashi, 2000 pg. 457, UN, 2001).

The EEZ as a juridical zone would subsequently be highlighted because the research area is located within the fringes of the two countries overlapping EEZ.

It is a zone which has emerged from the evolution of the Law of the Sea reflecting the efforts put in place to devise a transitional zone between the territorial seas, in which a coastal state has sovereignty subject to the right of innocent passage. The high seas constitutes an area whose use was hitherto regarded as traditionally free for all or 'Open Access' (Juda, 1986; Garcia & Hayashi, 2000; UN, 2001).

The creation of the EEZ, whose outline is embedded in Part V of the 1982 UN Law of the Sea Convention represents a turning point from the Law of the Sea regime indoctrinated in the four previous conventions drafted at the first U.N. Conference on the Law of the Sea in 1958. In this system, the measurement of the high seas began at the outer limit of the territorial sea; while in the new law of the sea it is no longer the case as the EEZ has been interposed between the territorial sea and the high seas (Juda, 1986; UN, 2001).

The main aim of any marine management initiative is to achieve a long term ocean ecosystem's health via sustainable use of resources for the common benefit of humankind in a manner that does not negatively alter the state of the marine ecosystem (Folley et al, 2013). Attaining this requires commitments and institutional capacities.

There are however in place regulations by international institutions such as the International Convention for the Prevention of Pollution from Ships (MARPOL) and its subsequent annexes. They were designed to govern these adverse effects such as pollution within the marine environment so as to safeguard other living resources. This is in addition to emphasising in 1990s and the turn of the millennia the urgent need to safeguard the oceans and their resources in order to achieve ocean security (Oduntan, 2008; NBC et al., 2009; Suarez, Cicin-Sain, Wowk, Payet & Guldborg, 2014).

## **2.9 The development of institutions and institutional arrangements for marine environmental resources management**

Ostrom (1990, p.29) defined an 'institution as a set of working rules that are used to determine who is eligible to make decisions in a particular area, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided and what pay offs will be assigned to individuals dependent on their actions'.

While institutions devised by resource users have helped to sustain the productive use of fragile natural environments for centuries, it is through a better understanding of those institutions and their effects in enhancing or detracting from effective management that their design and implementation can be tailored for current and future resource management. This is more so because of the uniqueness of coastal and marine resources (Soares, 1998; Howard & Vince, 2008; Stojanovic & Ballinger, 2009).

Due to the uniqueness of coastal and marine areas and their jurisdictions, there is the need to study institutions. The impact of governance on institutional

arrangements and policy issues has become a key question within the sustainability paradigm (Stojanovic & Ballinger, 2009).

As the impact of governance on institutional arrangements and policy issues gained prominence within the sustainability paradigm, the need to study institutions so as to appreciate their uniqueness especially for coastal and marine areas and their jurisdictions that cut across land-sea interface became more relevant (Stojanovic & Ballinger, 2009).

However, institutions are only as efficient as how they are made to work; if they are not governed by rules they cannot work. A case in point is the assertion that weaknesses in the assumptions and operations of the free market which requires a perfect market for optimal distribution of resources to be achieved became a source of concern for resource managers (Ostrom, 1990).

The contemporary framework for oceans governance has been influenced by a number of international instruments as well as initiatives and institutions that complement and extend these instruments as expounded in Table 2.9.

Some scholars (Howard & Vince, 2008; Druel & Gjerde, 2013; Suarez, Cicin-Sain, Wowk & Sack, 2014) observed that over the past three or four decades, the international community has been involved in permanent negotiations that seek to establish an improved framework for the use of the oceans and for the more equitable management and conservation of marine resources. However, throughout these negotiations, there has been recognition of the need to create an appropriate institutional framework. However, this arguably has so far failed to result in a coherent system of ocean governance that may be devoid of conflicts (Soares, 1998; Garcia & Hayashi, 2000; Howard & Vince, 2008; Druel & Gjerde, 2013; Suarez, Cicin-Sain, Wowk & Sack, 2014).

Such apparent failure or deficiency has also been found to be further compounded by observed fragmentations among institutions, international agencies, and disciplines. Furthermore, lack of cooperation among nations sharing marine ecosystems, and weak national policies, legislation, and enforcement coupled with

institutionalised corruption all contribute to the need for a new imperative for adopting ecosystem-wide sustainable approaches to managing human activities in these systems in order to avoid serious social and economic disruption (Duda & Sherman, 2002).

The role of institutions in the development of ocean governance is basically to administer ocean resources. Several institutions have emerged over time simultaneously with the evolution of the ocean governance and its resources management so as to exercise control and institutionalise rules for the common benefit of resource owners and users (Garcia & Hayashi, 2000; Stojanovic & Ballinger, 2009).

There are a number of institutions internationally, regionally and nationally involved in managing marine environmental resources depending on the situation and resources being addressed and at which level as depicted in Table 2.6.

Table 2.6-Illustration of the typology of institutions (Source: Author's own)

<b>Types of Institutions</b>	<b>Roles</b>	<b>Examples</b>
International	Spearheading international arrangements between and among global community	UNGA UNEP UNDP IOC-UNESCO FAO
Regional	Rallying points for regional interests or priorities	OECD ECOWAS APEC GOGC WACAF EEA
<b>National</b>	<b>Articulation and implementation of national or local priorities</b>	<b>MMO</b> <b>DEFRA</b> <b>FME</b> <b>NOAA</b>

The following sections highlight the key institutions and some of their applications (necessary for understanding their theoretical underpinning) which contributed to

the ocean and sea use management that are of particular relevance to the foci of the thesis.

### **2.9.1 International institutions**

International institutions such as the United Nations General Assembly (UNGA) serves as an important forum in the development of ocean governance and their resolutions have led to initiatives and processes such as the enactment of the United Nations Convention on the Law of the Sea (UNCLOS) (Howard & Vince, 2008).

It is also under the United Nations auspices that the United Nations Conference on Environment and Development (UNCED) was convened giving rise to significant proclamations such as Agenda 21, which addressed inter alia managing the seas and oceans, together with their resources. Agenda 21 also promoted the integration and institutionalisation of policies and decision making processes both at the local and national levels for integrated management in addition to sustainable management of coastal and marine areas and their resources; with the key issues being sustainability and integration (Cicin-Sain & Knecht, 1998).

In recent times, there have been international institutional interventions in response to the challenges of developing management and assessment initiatives such as indicators for the sustainable development of marine resources through some agencies. These are Inter-governmental Oceanographic Commission, the National Oceanic and Atmospheric Administration, the European Environment Agency, the UN Commission on Sustainable Development, the United Nations Environment Programme and a host of others (Sherman et al., 2009; Sherman, 2014).

Others such as the United Nations Environment Programme (UNEP) provides support for developing capacities for regional strategies and national actions through its Regional Seas Programme (Howard & Vince, 2008). The UNEP-sponsored Regional Seas Programme is among the most important joint scientific assessments covering integrated management in addition to provision of comprehensive legal and institutional frameworks for international partnerships

and cooperation in coastal and marine affairs (Soares, 1998; Howard & Vince, 2008).

Similarly, others such as The United Nations Educational, Scientific and Cultural Organisation (UNESCO) in conjunction with Inter-governmental Oceanographic Commission (IOC) provides a coordinating role for a range of international programmes including the recently published indicators' methodologies for the five water courses (IOC-UNESCO, 2011). This is in addition to directly contributing to ocean governance through hosting the various conferences on Oceans and Coasts in the past (Howard & Vince, 2008).

Other key institutions are the Global Environment Facility (GEF) which is an initiative jointly sponsored by the World Bank, the United Nations Development Programme and the United Nations Environment Programme. The sole mandate of the GEF is the protection of marine environment, one manifestation of which is the institution's active involvement in the emergence and testing of the Large Marine Ecosystem (LME) concept and the development of its indicators respectively most recently in Africa (Sherman & Hempel, 2008; Sherman et al., 2009) and the Yellow sea (Sherman, 2014); aspects of which are of particular relevance to this thesis.

### **2.9.2 Regional institutions**

On a regional scale, there are a number of institutions which act as rallying points for specific or particular interests of the regional nation states concerned with managing a number of aspects of marine resources and serve as implementing units for region-wide protocols and conventions. Among these include the Organisation for Economic Cooperation and Development (OECD); which was established in 1961 and has been very active in the provision of analyses and general advice to member states on areas relating to general fishery matters including initiatives in combating IUU fishing (Howard & Vince, 2008).

Others are the Asia-Pacific Economic Cooperation (APEC), Economic Community of West African States (ECOWAS) and the Gulf of Guinea Commission. These institutions may usually lead to coordination in areas such as adoption of

conventions and protocols covering their defined area and a particular issue of interest (Ukwe et al., 2006; Sherman et al., 2009).

### **2.9.3 National institutions**

Perhaps the most important among all the institutions could be said to be national institutions. This is arguably because they are the ones charged with the responsibility of both articulating and implementing national or local priorities of nation states. In most cases also, regional and international institutions and their protocols and conventions are fashioned in line with the requirements and peculiarities of national institutions before being adopted at the regional and international levels (Cicin-Sain & Knecht, 1998; Howard & Vince, 2008; Uche-Okeke, 2008). Governments, the world over have been found to develop individual initiatives and policies separately.

In the U.K. for example, with the enactment of the Marine and Coastal Access Act 2009 for the integrated and sustainable development and management and protection of its marine environment, the Marine Management Organisation (MMO) was established in April, 2010 to take charge of all marine related issues. It was established to serve as a one stop shop for all marine activities with the sole objective of making a contribution to the achievement of sustainable development. Included within this scope are such functions as granting licences to fishing boats while several other functions formally under the Secretary of State was also transferred to the M.M.O. by the Act (DEFRA, 2009; Stojanovic & Ballinger, 2009).

However, some national institutional positions may conflict with regional provisions but such situations are usually resolved through consistent awareness campaigns and realignments where possible so as not to jeopardise other partners' concerns and interests (Ukwe et al., 2006).

One of the main challenges for a coastal state in addition to having strong and functional institutions is how to ensure the optimal preservation of its national coastal and marine resources and ecosystems, while exploiting them in a sustainable manner in order to drive their national development processes (Bray, 2000). Such exploitation is done to ensure a sustainable development and

management of marine resources that are transboundary in nature and cut across national jurisdictions and from an ecosystem based perspective. The use of the Large Marine Ecosystem LME concept has been adopted and supported by a number of scholars (Mangel, 1991; Alexander, 1993; Sherman, 1995; Uitto & Duda, 2002; Sherman et al., 2009a; Sherman et al., 2009b; Sherman, 2014).

### **2.10 The evolution of the Large Marine Ecosystem concept**

The emergence of UNCLOS has brought some rationality into the issue of marine environmental resources apportionment within the global oceans. There is however some concern due to the nature of seamless flow of both seawater and its living resources contained therein. It is natural that those resources do not respect boundaries or any lines drawn in the sea for the purposes of demarcation or ascertaining control (Hayashi, 1995; Garcia & Hayashi, 2000). As such, living resources of the oceans faced another fresh threat to their management as a result of their transboundary nature.

Two trends emerged that are of great relevance over the last three to four decades regarding the management of the living resources of the oceans. The first is establishing a clearly meaningful perspective considering the complexity of the global oceans' marine living resources on whether to pay emphasis on individual fish species or other resources within a geographical entity of the global oceans or on the interactions of the collective resources within an identified ecosystem (Alexander, 1993).

The second is on the realisation that slow progress towards regional cooperation at international level over marine resources management has been found to be the norm rather than the exception (Sherman, 1986; Wang, 2004). It is the combination of these trends that led to the emergence of the LME concept as an initiative that may be employed to manage marine resources in and around global ocean waters (Sherman, 1986; Alexander, 1993; Sherman, 2014).

The concept of LME gained prominence in the early 1980s when the framework for LME research was laid down by a consortium of oceanographers, fisheries biologists and ecosystem proponents. Following the joint biological and hydrological studies

commissioned by the ICES, scientists became more aware of the advantages of having a multidisciplinary dimension to fisheries science versus single species or sectoral approaches. The realisation in 1975 of fluctuations in fish stocks in the North Sea during an ICES convened symposium led to the commissioning of various symposia dating from 1984 for the development of the components of LME (Alexander, 1993; Sherman, 1986).

Similarly, the LME components could be traced to when the need for the establishment of a rational use and governance of the oceans and their resources comprising of both the living and non-living resources such as fish and fisheries and shipping and pollution control respectively emerged, which began to receive considerable attention over the last half a century (Alexander, 1993).

### **2.10.1 The theory and application of the LME concept**

Large Marine Ecosystems have been defined as ecologically rational units of ocean space that are characterised by distinct bathymetry, productivity, hydrography and tropically dependent marine living population that are usually 200,000 square kilometres or larger (Alexander, 1983; Sherman, 1995; Sherman, 2005; Sherman et al., 2009; Sherman, 2014).

The LME approach has been recognised as a global movement that incorporates the ecosystem based management (EBM) approach for the study and recovery of marine goods and services. It is currently being supported and endorsed by governments globally in Africa, the United States, Asia, Latin America and Eastern Europe in addition to financial institutions such as the Global Environment Facility (GEF), the World Bank as well as a broad scientific community (Alexander, 1993; Sherman et al., 2009; Sherman et al., 2009b; Sherman, 2014).

The concept of LME emerged as transition zones rather than entities with fixed lines within the marine ecosystem in the 1980s as a global phenomenon in response to several ICES conferences to manage LMEs. The LME concept, evolved with four clearly defined management stages-comprising of data acquisition, assessment and monitoring; planning; implementation and feedback system. For an LME to be effectively managed, 'objectives of the management effort, the

jurisdictional questions involved and the nature of the programme' (Alexander, 1993 pg. 191) must be considered from the outset about the region being considered (Sherman, 2009; Sherman, 2014).

The LME concept was also supported by a community of over 200 scientists, academics and policy experts since 2005, which recognises the use of LMEs for practicing ecosystem based research, assessment and management of ocean goods and services. This is in line with the need to have a broader place based approach to marine ecosystems assessment and management that focuses on clearly delineated marine ecosystems units (Sherman et al., 2009).

It has also been postulated that the natural characteristics of LMEs automatically function in line with ecosystem based management and as such requires ecosystem based approach to succeed as are currently been applied in the People's Republic of China, the republic of Korea and in the Yellow Sea LME (Wang, 2004; Sherman, 2005; Sharman et al., 2009; Sherman et al., 2009b; Sherman, 2014).

The LME concept uses the five modular approaches to the assessment and management of the marine ecosystems using indicators; an approach that has so far proven useful in ecosystem based assessments in the US, elsewhere and some parts of Africa (Sherman et al, 2009; IOC-UNESCO, 2011; Sherman et al., 2009b; Sherman, 2014). They are suites of indicators addressing productivity, fish and fisheries, pollution and ecosystem health, socioeconomics and governance. The first three involve natural systems while the last two involve human interactions with those systems (Juda & Hennessey, 2001; Sherman et al., 2009).

They are currently being employed to examine several water courses globally (Sherman et al., 2009; Sherman et al., 2009b; Sherman, 2014).

### **2.11 The importance of indicators in marine resource management**

An indicator is expected to provide a simplified view of a complex phenomenon by expounding insights about a trend or an event that may not be necessarily observed directly through the quantification, simplification and communication of information. There exists, however no single perfect definition of an indicator or a

set of indicators (Cordar, 2001). As such, the use of indicators must be tailored to their expected use.

Various scholars have individually defined indicators in line with their specific disciplines in terms of sustainable development. In coastal and marine resource management, indicators have been commonly defined as tools or instruments used to provide information about the state of coastal and marine ecosystems in order to promote a better understanding towards the communication and evaluation of environmental processes and policies (Garcia, Staples & Chesson, 2000; McGlade et al., 2002; Salas et al., 2006; Sherman et al., 2009; Heink & Kowarik, 2010; Beliaeff & Pelletier, 2011).

Indicators are believed to be able to simplify trends and conditions that can help decision makers in planning for sustainable development. This is due their characteristics of being able to represent quantitative elements or forces that drive a system of responses to forcing functions or of the past, present and future states of the ecological systems (Garcia, Staples & Chesson, 2000; McGlade et al., 2002; Salas et.al, 2006; Sherman et al., 2009; Heink & Kowarik, 2010 Beliaeff & Pelletier, 2011).

### **2.11.1 Characteristics of indicators of marine ecosystems state**

The ability of an indicator to combine numerous environmental factors into a single value making it easier for formulating ecological concepts and proffering management strategy has been identified as its main attribute which in turn helps in establishing useful connections between empirical researches and modelling (Sherman & Duda, 1999; Garcia, Staples & Chesson, 2000; Salas et al., 2006; Heink & Kowarik, 2010).

However, Salas et al. (2006) quoting Waltz (2000) and Meadows (1998) in UNESCO listed the following characteristics of an ideal environmental indicator as (a) possesses agreed scientifically sound meaning (b) represents an important environmental aspect of society (c) provides valuable information with readily understandable meaning (d) meaningful to external audiences (e) focuses on

information to answer important questions and (f) assists decision making by being cost effective and efficient to use.

Similarly, Lescrauwaet et al. (2006) and Heink & Kowarik (2010) explained three essential criteria of sound indicators as

- (a) Salient-which entails relevance and usefulness to the user that must show measurable indices that can serve as a benchmarking instrument for setting targets and showing trends
- (b) Credibility-which entails the scientific validity of the indicator and that the quality of the data, the methodology of acquisition and the adequacy of presentation must be credible
- (c) Legitimacy-which entails how the data used in formulating the indicator is perceived by the stakeholders and the external community

## **2.12 LMEs as tractable units of ocean space management**

As the unanimous adoption of multispecies assemblages as against single species consideration in the management of marine living resources gained importance among fisheries managers and scientists, the need to encompass entire ecosystems as management units became increasingly important and preferable as well. This is because considerations for optimizing their productivity will now include other relatively dependent populations and their environments as well (Juda & Hennessey, 2001; Sherman, 2005; Sherman et al., 2009; Sherman, 2014).

This must have been what led one of the earlier scholars such as Beddington (1980) to believe it is possible to reverse marine ecosystems exploitation, albeit only on the condition that the populations are considered as part of large marine ecosystems. This is as a result of being the only management model that focuses on ecological phenomena and guarantees compatibility with observation and theory on a multispecies scale (Sherman et al., 2009; Sherman, 2014).

This approach has also been known to be capable of mitigating difficulties in differentiating between natural and anthropogenic perturbations to ecosystems

components (Sherman, 2005). In addition to being found suitable for transboundary water courses (Sherman et al., 2009; Sherman et al., 2009b; IOC-UNESCO, 2011), it is also in line with the principles of ecosystem based management which highlights the paradigm shift from individual species consideration to ecosystems and from small spatial scale to multiple scales.

### **2.13 The development of the Transboundary Waters Assessment Programme**

It is because of the need to address these difficulties and challenges that the United Nations Environmental Programme (UNEP), under the auspices of the Global Environment Facility (GEF), coordinated the implementation of the Medium Size Project (MSP) for the Development of the Methodology and Arrangements for the GEF Transboundary Waters Assessment Programme (TWAP) involving a whole range of partners (IOC-UNESCO, 2011).

These partners included the International Hydrological Programme (IHP) of the UNESCO for transboundary aquifers including aquifers in Small Island developing states (SIDS); the International Lake Environment Committee (ILEC) for lake basins; the UNEP Centre for Water and Environment for river basins; and Intergovernmental Oceanographic Commission (IOC) of UNESCO for Large Marine Ecosystems and the open ocean (IOC-UNESCO, 2011).

The GEF approved the MSP in January 2009 in recognition of the importance of managing transboundary water concerns and the potential consequences of associated problems in addition to being aware that prior to 2011 a comprehensive assessment of transboundary waters has never been undertaken. The approval was also because the required institutional arrangements were not in place, in addition to the absence of a single global programme that focused on transboundary waters assessment (IOC-UNESCO, 2011).

Envisaged as a partnership among existing programmes, the GEF MSP project was considered to be more cost effective than the conduct of a standalone data and information gathering exercise. The Project objective was to develop the methodologies for conducting a global assessment of transboundary waters for GEF

purposes and to develop partnerships and arrangements for conducting such a global assessment. The project led to the development of separate methodologies for the five transboundary water systems (IOC-UNESCO, 2011).

One of the most important components of the GEF intervention is the conduct of a Transboundary Diagnostic Analysis (TDA) for transboundary water bodies so as to identify areas requiring intervention (IOC-UNESCO, 2011; Pernetta & Bowers, 2012; Tengberg & Cabanban, 2013).

### **2.13.1 The Transboundary Diagnostic Analysis**

The Global Environment Facility (GEF) as earlier noted is the financial mechanism that was established as a result of a consortium of several agreements under the auspices of the United Nations. It is considered to be the largest financial vehicle charged with the mandate of addressing present and future challenges to shared marine ecosystems. It does this by providing financial and sometimes technical support to countries undertaking TDA with a view to identifying their priority transboundary environmental concerns within their shared marine ecosystem at the LME scale (IOC-UNESCO, 2011; Pernetta & Bowers, 2012; Tengberg & Cabanban, 2013; Sherman, 2014).

The TDA led to the development of a Strategic Action Program (SAP). This is a system of addressing such concerns from regional to national to local levels. In this regard, the GEF has so far supported up to 22 transboundary surface water basins, 16 Large Marine Ecosystems, and 5 cross-border groundwater systems globally in regional collaborative efforts (IOC-UNESCO, 2011; Tengberg & Cabanban, 2013; Sherman, 2014).

From its inception in 1991 to its present fourth replenishment phase, the GEF has so far allocated US\$3.1billion in grants and over US\$6billion in co-financing for 132 transboundary shared waters projects under its International Waters (IW) focal area in about 147 countries and counting (Tengberg & Cabanban, 2013; Sherman, 2014).

One of such examples in the interventions is in the Guinea Current Large Marine Ecosystem where the research area is located (Sherman, 2014) and in East Asian region (Tengberg & Cabanban, 2013).

### **2.13.2 The Transboundary Diagnostic Analysis (TDA) for the Guinea Current Large Marine Ecosystem (GCLME) countries**

The Transboundary Diagnostic Analysis identified the following threats and issues; namely, ‘fish stocks depletion and unsustainable harvesting of living resources, loss of ecosystem integrity, deterioration in water quality, habitat destruction and alteration’ for the GCLME countries (IOC-UNESCO, 2011 p. 93; Pernetta & Bowers, 2012).

However some scholars such as Pernetta & Bowers, (2012) and Tengberg & Cabanban, (2013) observed that the ‘pre-selection’ of priorities within the issues that the TDAs attempt to address made the justification of awarding the GEF funding difficult to assess both in terms of determining a particular ecosystem perspective and the wider global environmental perspectives. Although they recognised the applicability of the GEF concept of TDA but strongly propose the preparation of independent general guidelines that may be applicable anywhere so as to justify further GEF funding for similar projects (Pernetta & Bowers, 2012; Tengberg & Cabanban, 2013). This could further be compounded due to the absence of specific sub-LME area initiatives in assessing transboundary shared water systems smaller than an LME area.

### **2.14 The dearth of specific sub-LME marine resource management/ assessment initiatives**

Due to the realisation of the existence of smaller assessment units (such as the research area) within identified LME areas that are considered as special habitats of interest and transboundary hotspots such as coral reefs, mangroves, estuaries and contested or shared water bodies. The need to develop specific sub-LME assessment initiatives was recognised during the GEF MSP project for the TWAP LME water courses (IOC-UNESCO, 2011).

This is to enable such an assessment to better capture the diversities and peculiarities of such habitats and thereby support an ecosystem-based approach to marine resource management. This would be in addition to facilitating the assessment of transboundary issues such as the JDZ. In order to apply an ecosystem-based approach, there is the need to ensure that planning units based on natural regions are defined on a range of hierarchically-nested scales, depending on the purposes. As such, classification and mapping of such habitats has been identified as a gap that needs to be studied by further research (IOC-UNESCO, 2011).

## **2.15 Summary**

Chapter Two examined the theoretical and conceptual components of marine resource management generally. In Section 2.2 the theory and process of marine resource management was discussed while components in Section 2.3 examined the nature and the characteristics of the marine environment in addition to the need for management.

Sections 2.4 and 2.5 examined the evolution of management of marine living resources and marine spatial planning and its processes respectively. Section 2.7 examined the need for an ecosystem based management and its associated arrangements while Section 2.8 evaluated the evolution of the law of the sea and the division of the ocean space into management units.

Sections 2.9 and 2.9.3 highlighted the development, role and arrangement of institutions for marine environmental resources management while Sections 2.10 to 2.13 examined the evolution, theory and application of the LME concept. This in addition to examining the division of the ocean space into management units, trends in transboundary LME management issues as well as the development of the Transboundary Waters Assessment Programme.

Sections 2.13 and 2.14 examined the Transboundary Diagnostic Analysis conducted for the Gulf of Guinea and finally highlighted most importantly the absence of specific sub-LME marine resource management and assessment initiative suitable for areas such as the research area.

Section 2.15 contained the summary of the whole chapter.

## Chapter Three: Marine resource management in practice

### 3.1 Introduction

This chapter discusses the practice underpinning the application of marine resource management initiatives. The adoption of the DPSIR framework as the framework component of ecosystem based management approaches. Firstly, it will examine the overview of key ecosystem based fisheries management approaches and highlight examples from the Gulf of Guinea in addition to characteristics of Small Island Developing States. Secondly, it will examine the development of trends in transboundary LME management issues. Thirdly, it will critically discuss the evolution, importance and characteristics of indicators for marine resource sustainability and examples of their typology and application around the globe in areas such as the EU, Australia and the Gulf of Guinea. Fourthly, the concept of joint development arrangements for marine resource management as well as challenges of IUU fishing and their mitigation will also be examined. Finally, the chapter will also highlight alternative fisheries management schemes and how they might be used to curb IUU fishing.

### 3.2 The Driving Forces-Pressure-State-Impact-Response framework component of the EBFM

The concept of **Driving Forces** may be explained as the force which exerts **Pressure** as a result of any activity on the environment and which as a consequence leads the **State** of the environment to change. This then leads to **Impacts** on the whole ecosystems, ecosystem's health, and the larger society, which may elicit a societal **Response** that tends to elicit feedback on the whole cycle (Maxim, Spangenberg & O'Connor, 2009). It has also been observed that a one degree climate warming resulted in a reduction of primary productivity within the North Sea LME (Sherman et al., 2009b) leading to decline in fish biomass yield as illustrated in Figure 3.0.

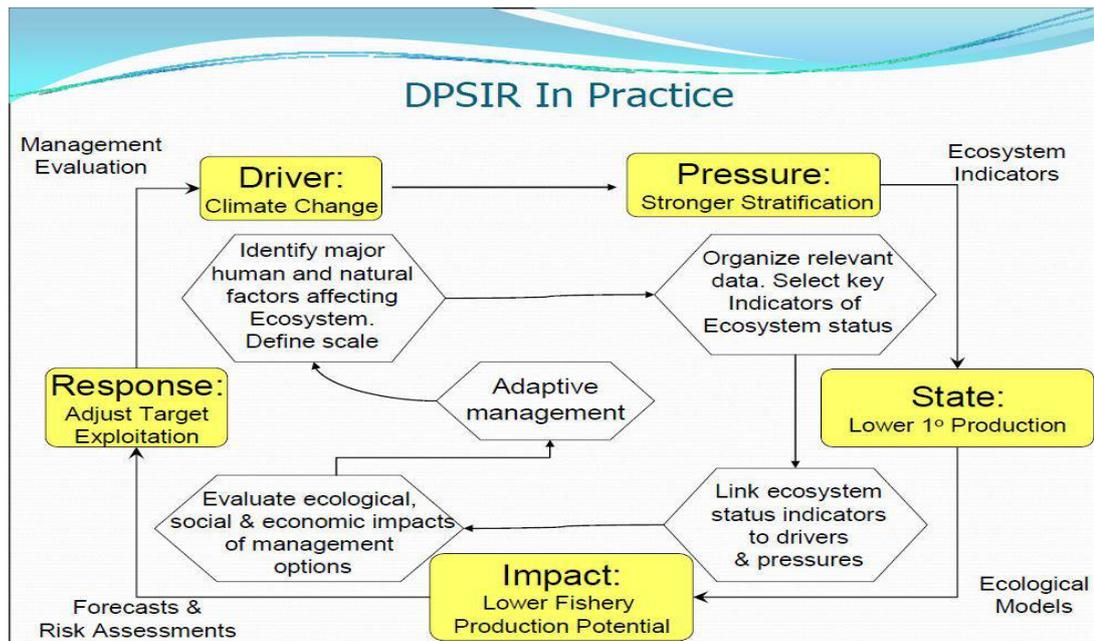


Figure 3.0- The DPSIR framework cycle from North Sea (Modified from Sherman et al., 2009)

The Driving forces-Pressure-State-Impact-Response (DPSIR) framework was first developed by the Organisation of Economic Cooperation and Development (OECD) during the latter part of the 1990s before being adopted by other international and regional institutions like the European Environment Agency (EEA). It was developed to serve as a framework for the structuring and organisation of information so as to be made more meaningful to managers and policy makers for decision making purposes (Rogers & Greenaway, 2005; Sherman, 2006; Tscherning et al., 2012).

The European Environment Agency EEA also recognised and adopted an information based assessment that uses the DPSIR framework together with the issue/thematic approach in monitoring and reporting on a range of water quality assessments in line with the implementation of EU directives (Rogers & Greenaway, 2005).

The DPSIR framework approach, developed as an approach to WSSD targets is tailored, tested and specifically found to be very relevant to the LMEs by defining it on the basis of bathymetry, hydrography, productivity and trophically interdependent populations of clearly delineated and ecologically rational units of ocean space (Rogers & Greenaway, 2005; Sherman, 2006; Fanning et al., 2007).

This must have been the reason why several scholars are of the view that one of the most common attributes all assessments including those employing indicators (local, national, regional, international and institutional) exhibit is their ability or compliance in measuring changing ecosystem states. This is in line with the framework of the Driver-Pressure-State-Impact-Response (DPSIR) system as well as Ecosystem Based Management (EBM) strategies both of which are in support of adaptive management actions (Vandermeulen, 1998; Barrera-Roldan & Saldiver-Valdes, 2002; Ehler, 2003; Pickaver et al., 2004; Rogers & Greenaway, 2005; Sherman, 2006; Hoagland & Jin, 2008; Sherman et al., 2009; Marques et al., 2011; Ferreira et al., 2011; Beliaeff & Pelletier, 2011).

Similarly, the generality of the scientific community (Rogers & Greenaway, 2005; Marques et al., 2011) observed the DPSIR framework to have played an important role in selecting relevant objectives and managing environmental quality through the adoption of an EBM approach to management of marine resources. This is done by observing the exertion of pressure on the ecosystem and its various components such as social and economic policies as well as natural and environmental changes. This is in addition to observing changes in productivity as observed in the North Sea LME (Sherman et al., 2009b) and the Yellow Sea LME (Sherman, 2014).

A typical example in the management of the marine environment could be found in the Guinea Current Large Marine Ecosystem (GCLME); which is among the five most productive marine ecosystems in the world as earlier reported in Section 1.1.1. The region has abundant fishery resources, immense oil production and a region of critical importance to marine biological diversity (Ibe & Sherman, 2002; Ukwe, Ibe, Ilo & Yumkella, 2003; Ukwe, Ibe & Sherman, 2006). The GCLME covers from Bissagos Island (Guinea Bissau) in the north to Cape Lopez (Gabon) and Angola in the south including the Exclusive Economic Zones (EEZ) of sixteen countries as earlier depicted in Figure 1.1. These include Angola, Benin, Cameroun, Congo, Cote d'Ivoire, Democratic Republic of Congo, Gabon, Ghana, Equatorial Guinea, Guinea, Guinea Bissau, Liberia, Nigeria, Sao Tome & Principe, Sierra Leone and Togo. The area supports the livelihoods of many communities living along the coast. Over 40% of the approximately 300million people of the region's population live along the

coast, and are dependent on the lagoons, estuaries and creeks surrounding them for subsistent fishery (Chukwuone et al., 2009).

### **3.3 Overview of ecosystem based fisheries management approaches in the Gulf of Guinea**

There are over 300 species of finfish, 17 species of cephalopods, 25 species of crustaceans, and 3 species of turtles. These resources are exploited by both artisanal and industrial fishing fleets, the latter of which is made up of both local and foreign vessels (Duda & Sherman, 2002; Ukwé et al., 2006; Chukwuone et al., 2009). Over 60% of the national fish landings in the area are carried out by artisanal fishers while consistent over-fishing in the face of scientific warnings, fishing down food webs, destruction of habitat, and accelerated pollution loading—especially nitrogen export and oil production—have resulted in significant degradation to coastal and marine ecosystems of both developed and underdeveloped nations (Ukwé et al., 2003; Falaye, 2008; Ukwé & Ibe, 2010). Fragmentation among institutions, international agencies, and disciplines, lack of cooperation among nations sharing marine ecosystems, and weak national policies, legislation, and enforcement coupled with institutionalised corruption (especially in the Gulf of Guinea countries) all contribute to the need for a new imperative for adopting ecosystem-based approaches to managing human activities in these systems in order to avoid serious social and economic disruption (Duda & Sherman, 2002; Ukwé, Ibe & Sherman, 2006; Ukwé & Ibe, 2010).

The importance of the Gulf of Guinea (GOG) coastal and marine ecosystem to socio-economic development of the countries in the region has been widely recognised by several scholars (Duda & Sherman, 2002; Scheren et al., 2002; Ibe & Sherman, 2002; Ukwé, Ibe, Alo & Yumkella, 2003). This is on account of its vast array of marine living and non-living resources including fisheries; however, the health of the coastal ocean is increasingly in jeopardy as a result of a rapid intensification of human activities. Pollution in the region has caused eutrophication and oxygen depletion in the lagoon system especially around the urban centres which resulted in a decrease in fish production levels and waterborne diseases. When six countries in the region undertook pollution source assessment as a first step to define a

region wide Environmental Management Plan, they found the oil industry especially the Nigerian petroleum industry responsible for the substantial amounts of hazardous wastes and also for the spilling of large amounts of oil (Ukwe et al., 2006).

The pollution source assessment aimed at defining a region wide Environmental Management Plan also focused on reducing pollution from land based activities most especially industries. This was achieved through a sustained survey of the productivity of the ecosystem by ships of opportunity, a successful region wide fish trawl survey and community based mangrove restoration efforts (Ukwe et al., 2006). It also provided impetus for the formulation of National Integrated Coastal Areas Management Plans that are based on common regional policies and strategies. It also enhanced the capacity to intervene meaningfully in the protection of the environment and in taking preventive measures with definitive steps geared towards institutionalizing the GIS based decision making support systems (Ukwe et al., 2006; Ukwe & Ibe, 2010).

For over a century, the region has witnessed an increased deterioration of the environment with its attendant social, economic and health implication for the citizenry (Ukwe & Ibe, 2010). Other challenges faced by countries in the region include; high population growth with urbanisation, fish and fisheries depletion, pollution, poor land use planning and habitat degradation, coastal erosion and flooding as well as manipulation of the hydrological cycles (Ukwe, Ibe, Alo & Yumkella, 2003). All these took place as a result of a lack of unified framework for sustainably managing the fisheries resources.

These rich fishery resources are of both local and international importance with stocks supporting artisanal fisheries and offshore industrial fisheries from many nations. Most of these straddling and migratory stocks have attracted large commercial fishing fleets from around the world, especially from the former Soviet Union, European Union, Eastern Europe, Republic of Korea, and Japan who mostly engage in illegal fishing activities (Ukwe et al., 2006; Falaye, 2008).

### **3.3.1 Region-wide initiative for combating pollution in the Gulf of Guinea**

As a result of these illegal activities most notably between 1995 and 1999; six countries, namely; Benin, Cameroon, Ivory Coast, Ghana, Nigeria and Togo in the region cooperated in a Global Environment Facility funded pilot project which focused on reversing the degradation of coastal and marine environment as well as ensuring long term sustainability of the region's ample but shared resources through an ecosystem approach to management (Ukwe, Ibe, Alo & Yumkella, 2003). The project also focused on reducing pollution from land based activities most especially industries and was achieved through a sustained survey of the productivity of the ecosystem by ships of opportunity, a successful region wide fish trawl survey and community based mangrove restoration efforts. It also provided impetus for the formulation of National Integrated Coastal Areas Management Plans that is based on common regional policies and strategies (Ukwe, Ibe, Alo & Yumkella, 2003).

A declaration was adopted by the six countries in 1998 and later together with the other ten countries making sixteen (mentioned in Section 3.2 and depicted in Figure 1.1) embodying political intellectual and material commitments to environmentally sustainable development of the Guinea Current Large Marine Ecosystem (Ibe & Sherman, 2002).

The Declaration provided the collaborative framework for joint actions by the 16 countries for living marine resources and coastal and marine environmental management in the GCLME. The living marine resources and environmental goals of the project are consistent with the FAO Fisheries Code of Conduct as well as WSSD Plan of Implementation targets on Oceans and Coasts and the Abidjan Convention for Co-operation in the Protection, Management and Development of the Marine and Coastal Environment of the West and Central African Region adopted in March 1981 (Ibe & Sherman, 2002; Scheren et al., 2002; Sherman, 2006; Ukwe et al., 2006; Chukwuone et al., 2009).

The Pilot project, which was limited to the six countries, initiated the work of stemming the loss of biological diversity and fisheries overexploitation and

mitigating pollution pressures on International Waters of the Gulf of Guinea by fostering regional co-operation predicated policies and strategies as well as joint institutional mechanisms. While in the areas of cooperation, Nigeria and Sao Tome & Principe signed a treaty to jointly explore their marine resources (hydrocarbon and non-hydrocarbon) in 2001 and has since commenced operation with the headquarters in Nigeria (Ukwe et al., 2006; Chukwuone et al., 2009).

Presently, the Abidjan Convention for Co-operation in the Protection, Management and Development of the Marine and Coastal Environment of the West and Central African Region and its Protocol on Cooperation in Combating Pollution in Cases of Emergency are the legal components of the West and Central African (WACAF) Action Plan for protection of the coastal and marine environment (Ukwe, Ibe, Alo & Yumkella, 2003; Ukwe et al., 2006). The convention expresses the decision of the WACAF region (from Mauritania to Angola at the time of adoption) to deal individually and jointly with common fisheries resources and marine and coastal environmental problems. The Convention also provides an important framework through which national policy makers and resource managers can implement national control measures in the protection and development of the marine and coastal environment and the living marine resources of the WACAF Region encompassing the GCLME (Ukwe et al., 2006).

However, only 14 countries had by 2010 ratified the Abidjan convention; which indicates a poor commitment towards the convention which in turn slows down the internationalization process of its obligations within national legislations (Ukwe & Ibe, 2010).

The main challenge for the coastal states of the Gulf of Guinea as observed earlier in Section 2.9.3 is how to ensure the optimal preservation of the region's coastal and marine resources and ecosystems, while exploiting them in a sustainable manner in order to drive their national development processes. As such, overcoming this challenge requires a comprehensive region wide ecosystem based approach to management so as to achieve optimum utilisation of these resources. However, this has not been achieved yet although ongoing participation by some

West African countries in the GEF funded LME assessments hold some encouraging promises. Among the West African countries sharing the Gulf of Guinea is a small island developing state of Sao Tome & Principe made up of two archipelagos. It is also one of the two countries sharing the research area.

### **3.4 Characteristics of Small Islands Developing States (SIDS) fisheries management approaches**

Due to the nature and proximity to the oceans and their dependence on its resources for virtually all forms of livelihood Small Islands Developing States (SIDS) have been recognised and given special mention in various international instruments such as the UNCLOS, UNCED and WSSD regarding the use of the oceans and its resources.

These instruments and conventions have recognised the specific needs and challenges inherent in SIDS to pursue the concept of sustainability since the 1992 Rio conference which recognised them as both economically and ecologically fragile entities deserving special attention and protection (Ghina, 2003).

Almost all SIDS depend on fishery and marine-based tourism for their survival (Ghina, 2003). SIDS such as the Seychelles whose economy is completely dependent on marine-based tourism and fishery as it provides over 26 per cent of the GDP and 30 per cent of the available job in addition to generating well over 70 per cent of foreign exchange earnings is a typical example (Jumeau, 2013).

Also among the most significant threats to any coastal zone of any SIDS are issues such as marine pollution, sea level rise, ocean acidification and consistent pressures on coral reefs which are common because of the attraction to their beaches by overseas tourists and the dependence of SIDS on subsistent fishing (Pelling & Uitto, 2001).

Apart from geographical isolation, most SIDS have very limited resources and are largely dependent on international trade for survival thereby making them vulnerable to market fluctuations (Ghina, 2003). This is in addition to being usually

very small in size inhabiting a usually dispersed parcel of land most especially in an archipelagic SIDS (Ghina, 2003) such as Sao Tome & Principe.

As such, based on these challenges and their near total dependence on the oceans and its resources, they readily adopt an ecosystem approach to managing their fisheries most especially when the shortcomings they usually face over the conservation and management of the natural resources are considered (Aqorau, 2000). It remains to be seen, however, if appropriate institutional frameworks are readily in place in most SIDS as evidence of successful adoptions are yet to be fully reported. The SIDS do however require adapting quickly to market forces fluctuations most especially when illegal fishing threats and its consequence on their economies are factored in as well.

As such, most SIDS now look to protecting their resources through establishing initiatives such as adopting the concept of setting up Marine Protected Areas not just as protection for their resource biodiversity but as a sustainable development initiative (Pomeroy, Watson, Park Sid, 2005). This provides the possibility of greatly serving their interests especially if enforcement can be guaranteed as they are also usually equally vulnerable to illegal fishing.

However, issues of transboundary management of straddling resources on which most of these SIDS depend especially in terms of establishing, asserting and maintaining property rights (Jumeau, 2013) often prove to be a challenging task despite the existence of international legislations.

### **3.5 Trends in transboundary LME management issues**

It has been observed that the water systems of the world comprising of aquifers, lakes/reservoirs, rivers, large marine ecosystems, and open ocean have been found to be supporting the socioeconomic development and wellbeing of almost all the world's population (Sherman et al., 2009; IOC-UNESCO, 2011; Sherman, 2014). While the majority of these systems are also known to be shared by two or more nations thereby making these transboundary resources interlinked by a complex web of environmental, political, economic and security interdependencies (IOC-UNESCO, 2011; Suarez et al., 2014).

These ecosystems are characterised by a range of ecological functions and processes that are essential to their regulation and continuous provision of ecosystem services beneficial to human welfare and society. However, these waters face continuous degradation by multiple, conflicting and sometimes complex human-induced stresses, making sustainability of their continued exploitation at this rate and the current environmental management in place a profoundly significant challenge (IOC-UNESCO, 2011).

Growing water and water resources demands herald increased frequency in conflicts. These conflicts are often between national governments, sub-national governments even within countries and sometimes between users with conflicting demands (Garcia & Hayashi, 2000; Uitto & Duda, 2002). This is further complicated by the fact that a larger percentage of the global water resources now fall under one or more national jurisdictions as a result of apportionment of the ocean space by UNCLOS (Garcia & Hayashi, 2000; Uitto & Duda, 2002; IOC-UNESCO, 2011).

A typical example could be found in the Gulf of Guinea which is acknowledged to have very rich fishery resources that are of both local and international importance with stocks supporting artisanal fisheries and offshore industrial fisheries from many nations (Chukwuone et al., 2009). Most of these straddling and migratory stocks have attracted large consortia of illegal industrial scale fishing fleets from around the world, especially from the former Soviet Union, European Union, Eastern Europe, Republic of Korea, and Japan as observed earlier in Section 3.3 (Ukwe, Ibe, Alo & Yumkella, 2003; Ukwe et al., 2006).

But managing transboundary water courses and their inherent resources can contribute to, and support the drive to sustainable development. Nation states can share their common water resources for mutual benefits rather than engaging in conflicts over these resources so long as structures for the collaboration are created while threats are recognised and appreciated objectively through negotiations (Uitto & Duda, 2002; Ukwe et al., 2006; Sherman, 2014; Broggiato et al., 2014).

As such there is the need for urgent intervention so as to be able to manage these conflicts and reduce tensions arising from the use of these transboundary resources

for the common benefits of humankind and sustainable development of oceans' resources (Broggiato et al., 2014). One important way this could be done is through appropriate and effective assessment employing indicators to support decision making processes.

### **3.6 Evolution of marine indicators for marine resource sustainability**

The concept of sustainability that is achievable through the various processes of sustainable development gained prominence in the last two decades or so through the adoption of the 'concept of sustainable development'. It was published in 1987 as the 'Brundtland Commission' report which defined it as a development that meets the needs of the requirements of current generation in a manner that does not jeopardise the ability of the future generations to also meet their needs (Sneddon, Howarth & Norgaard, 2006; Lescauwaet et al., 2006; Heink & Kowarik, 2010).

Subsequently, the 1992 United Nations Conference on Environment and Development through the declaration of Agenda 21 urged the development of indicators of sustainable development (Agenda 21, 1992; Lescauwaet et al., 2006).

The approval in 1995 of a five year programme of works on indicators for sustainable development came from the third session of the Commission on Sustainable Development. The main objective was to provide a core list of indicators of sustainable development that is accessible to decision makers at all levels. This led to the adoption of the World Summit on Sustainable Development (WSSD)'s Plan of Implementation in 2002. The plan required the strengthening of national, regional as well as international information with statistical and analytical services that are relevant to sustainable development policies and programmes in addition to encouraging and promoting further work on indicators for sustainable development (Sherman & Duda, 1999; McGlade et al., 2002; Lescauwaet et al., 2006; Sherman, 2006).

There are several national, sub regional, regional and international institutions involved in the development of indicators for sustainable development since the

UN call. Examples are the European Union (EU) set of indicators, the United Nations through the CSD set of indicators, the Large Marine Ecosystems (LME) set of indicators in addition to others such as ones developed as 'Coastal Sustainability Standard' by Gallagher (2010).

These indicators are usually sets for various facets of sustainable development. The indicators relevant to coastal and marine resource management and particularly the research area will be considered and evaluated in Sections 3.6.1 to 3.7.

### **3.6.1 The UN Commission on Sustainable Development indicators**

The CSD put forward a core set of fifty indicators with ninety six sub themes of the indicators describing the themes, sub themes, methodologies and guidelines for each of the indicators (UN, 2007).

Among the thematic descriptions of the CSD indicators, the following are hereby presented with their sub-themes as a result of relevance to the research area namely; (a) Oceans, seas and coasts (b) Freshwater (c) Biodiversity (UN, 2007).

Under the oceans, seas and coasts theme, the marine environment sub theme has the 'proportion of marine protected areas', the 'marine tropic index area of coral reef ecosystems' and the 'percentage of live cover' as main indicators. The fisheries sub theme has as a core indicator the 'proportion of fish stocks within safe biological limits' (UN, 2007).

The freshwater theme has 'water quality' as a sub theme. This has a further set of three indicators namely; (a) Annual withdrawal of ground and surface water as a percentage of total available water (b) Biological Oxygen Demand (BOD) in water bodies (c) Concentration of faecal coli form in freshwater (UN, 2007).

While in the biodiversity theme, the sub themes are ecosystems and species and have all together three key sets of indicators as (a) Area of selected key ecosystems (b) Protected areas as a percentage of total area (c) Abundance of selected key species (UN, 2007).

It should be noted however that among the various indicator initiatives globally, two are of particular importance to this study in terms of the significance of their contribution to the field of marine indicators generally and to the management unit being studied. They are the EU-WG indicators and the TWAP LME indicators respectively. The TWAP LME indicators were developed from the core LME indicators and are very much similar as will be subsequently shown in Section 3.6.4.

### **3.6.2 The European Union Working Group on indicators**

The EU through the working group on indicators and data (WG-ID) put forward two main groups of indicators in 2003-the progress and sustainability indicators. The progress indicators proposed by the WG-ID considered four phases of measuring the progress of Integrated Coastal Zone Management (ICZM) within the EU coasts in line with the principles of ICZM. The sustainability indicators proposed considered twenty seven sets of indicators to measure the sustainability of resource development along the EU coasts (Breton, 2006; EEA, 2006).

The four phases considered for measuring the progress indicators developed by the WG-ID put forward the following situations as assumptions within the coastal and marine environment where: (1) Planning and management are taking place in the coastal zone (2) A framework exists for taking ICZM issues forward (3) Most aspects of an ICZM approach to planning the coast are in place and functioning reasonably well (4) An efficient, adaptive and integrative process is embedded at all levels of governance and is delivering greater sustainable use of the coast (Breton, 2006; EEA, 2006).

Results from the implementation of these phases as demonstrated in the Table 3.0 revealed that; for phase 1-It is almost completed as at 2005 status among the EU countries and has therefore been termed as good evolution. In phase 2-while it has been observed that generally most of the actions are being implemented, some among the actions however tend to present some problems in addition to noticing some sectoral management though with a view to tending towards integration. As such, significant progress has been reported during the same period where some countries exhibit clear intention of working towards integration like France and

Belgium (Breton, 2006; EEA, 2006) and more recently the UK through enacting the Coastal and Marine access Act, 2009.

Table 3.0-Summary of ICZM testing of indicators Modified from: (EEA, 2006).

Phase	2000 Status	2005 Status	Trends and Comments
1. Planning and management are taking place in the coastal zone	Elemental actions have been taken much. Sectoral plan exists, as well as monitoring	This phase is completed in practically all the countries, even though sectoral is still preponderant	Good evolution
2. A framework exists for taking ICZM forward	Only actions 6 and 9 are eventually put in place	Actions 11 and 12 present more problems, but in general other actions are being implemented. Generally there are still sectoral, but with a view to go towards integration.	It is the phase which shows more progress during the period. Some countries have even begun clearly to work in the direction of integration. It is the case for France and Belgium. But the trends are general for all countries.
3. Most aspects of an ICZM approach to planning and managing the coast are in place and functioning reasonably well	Not developed	A number of positive answers are shown, even though different in every country. Still lot of work to do.	Some progress, but very significant in quality as it shows a real interest in the construction of ICZM. Actions tackled depend on priority given by each country. Effort should be undertaken during subsequent years.
4. An efficient, adaptive and integrative process is embedded at all levels of governance and is delivering greater sustainable use of the coast	Not developed	Not developed	The attainment of real ICZM lies in this phase, which has to be the main objective for the subsequent years.

In phase 3- significant progress appeared to have been observed with variations between and among different countries indicating a clear need for some work to be done during the period under consideration. It however revealed real interest by participating countries in the construction of ICZM, though the actions depend on the priority given by each of the countries. As such, more efforts have been suggested to be undertaken in the coming years (Breton, 2006; EEA, 2006).

There is no significant effort observed for the phase 4-which has been termed as undeveloped during the period under review. Comments were however put forward highlighting that the attainment of a real ICZM lies in this phase and therefore it is recognised as the main objective for the coming years (Breton, 2006; EEA, 2006).

### 3.6.3 The Large Marine Ecosystem indicators

Among the institutional interventions in response to the challenge of the coastal and marine indicators for sustainable development put forward is the suit of five modular indicators specifically tailored for the LMEs. This is supported by a community of over 200 scientists, academics and policy experts in 2005 when they recognised the use of LMEs for practicing ecosystem based research, assessment and management of ocean goods and services. This is in line with the need to have a broader place based approach to marine ecosystems assessment and management that focuses on clearly delineated ecosystems units (Sherman et al., 2009; Sherman, 2014). These set of five modular marine indicators are grouped into (a) Productivity module (b) Fish and fisheries module (c) Pollution and ecosystem health module (d) Socio-economic module and (e) Governance module (Sherman et al., 2009; Sherman, 2014) as visualised in Table 3.1 along with what they measure.

Table 3.1-LME indicator modules and measurements (Source: Author's own)

LME Module Indicator	What it measures
Productivity Module Indicator	1. Photosynthetic activity 2. Zooplankton biodiversity 3. Oceanographic variability 4. Zooplankton biomass 5. Ichthyoplankton biodiversity
Fish & Fishery Module Indicator	1. Demersal species 2. Pelagic species 3. Ichthyoplankton surveys 4. Invertebrate surveys 5. Essential Fish habitat 6. Marine Protected Areas
Pollution & Ecosystems Health Module Indicator	1. Eutrophication levels 2. Pollution levels 3. Global watershed nutrient transport
Socio-economic Module Indicator	1. Integrated assessments 2. Human forcing 3. Sustainability of long term social and economic benefits
Governance Module Indicator	1. Transboundary delineation 2. Intervention measures for remedies

### **3.6.4 The Transboundary Waters Assessment Programme Large Marine Ecosystem (TWAP-LME) indicators.**

The TWAP-LME indicators are very similar to the LME indicators and are differentiated only to reflect the transboundary nature of the five water courses they were designed for.

The TWAP LME indicators are based on five modular suites of indicators and were developed as a result of the need for a uniform, systematic and scientifically robust methodology as well as institutional arrangements that could be used to assess the dynamic nature of transboundary water courses. These are ground water aquifers, lakes/reservoirs, river basins, LMEs and open ocean areas. The result is a separate methodology for each of the water courses (IOC-UNESCO, 2011).

The LME approach has been found to be effective for delineated units of marine space (Sherman, 1986; Fanning et al., 2007; Alder & Pauly, 2008; Sherman et al., 2009; Sherman, 2014). This is one of the reasons that the TWAP LME indicators are considered most appropriate for the assessment.

The five modular approaches to the assessment and management of the LMEs has so far proven useful in ecosystem based assessments in the US, some parts of Europe and some parts of Africa-as observed earlier in Sections 2.10, 2.10.1 and 2.12. This is through the use of the suites of indicators of productivity, fish and fisheries, pollution and ecosystem health, socio-economic and governance with clearly embedded measurable variables and currently being proposed for the TWAP LME assessments in partnership with the International Oceanographic Commission (IOC-UNESCO) (Sherman et al., 2009; IOC-UNESCO, 2011; Sherman, 2014).

The indicators and their details are evaluated in Section 3.7 based on what they measure, usefulness, methodology, accessibility, relevance, sources, references and availability of data in a module by module criterion.

#### **3.6.4.0 The productivity module indicator**

The productivity module has three main TWAP indicators; namely primary productivity, sea surface temperature and oceanographic fronts.

#### **3.6.4.1 The primary productivity**

It is one of the indicators that measure ecosystem productivity and is used together with chlorophyll to examine coastal and marine eutrophication and its methodology is derived from satellite-borne data which originate from ocean colour sensors including the Coastal Zone Colour Scanner (CZCS), the Sea-viewing Wide field of view sensor (SeaWiFS) and the Moderate Resolution Imaging Spectroradiometer (MODIS-Aqua and MODIS-Terra). Its main relevance is classification of the LMEs into 3 categories. Data for the 64 delineated LMEs could be sourced from the NOAA and University of Rhode Island and are freely accessible online in the form of satellite images (Sherman & Hempel, 2008; IOC-UNESCO, 2011).

#### **3.6.4.2 The sea surface temperature**

It is another indicator that measures ecosystem productivity which is useful for detecting variability in ocean temperature trends. Its methodology is based on data computation from the UK meteorological office-Harley centre-from where SST climatology was used to compute 50 year time series of SST trends and anomalies within the global LMEs. Its main relevance is due to its ability to provide meaningful assessment of LMEs heating or cooling. The resulting SST trends for all the 64 LMEs are available online in the form of a digital map depicting the temperature status for all the delineated LMEs (Sherman & Hempel, 2008; Belkin, 2009; IOC-UNESCO, 2011). There are digital maps showing temperature trends of all the global LMEs on the NOAA website.

#### **3.6.4.3 The oceanographic fronts**

The oceanographic fronts indicator is the third indicator within the ecosystem productivity module and are used for climate change monitoring, prediction and for fishing as well as marine mining industries and their methodology is determined by frontal data archive through the association of SST fronts with chlorophyll fronts and lend themselves to marine physical-biological correlations once digitized. They are relevant in that they affect ecosystem productivity as a zone of enhanced horizontal gradients of physical, chemical and biological properties. The first survey of all the LME fronts was based on the frontal data assembled at the University of

Rhode Island and are available on the NOAA website though not easily accessible (Sherman & Hempel, 2008; Belkin & O'Reilly, 2009; IOC-UNESCO, 2011).

### **3.6.5.0 The Fish and Fishery module indicator**

The fish and fishery module has eight main TWAP indicators; namely the reported landings, value of reported landings, marine trophic index and fish in balance index, ecological footprints of fisheries, stock status plots, fishing efforts, projected catch potential and LME carrying capacity in relation to maximum sustainable yield.

#### **3.6.5.1 The Reported landings**

It is one of the indicators of the fish and fishery module used for identifying species composition and functional groups. Reported landings are determined by time series of reconstructed landings from 1950-2006 through mapping developed by Watson et al., (2004) and reported for each of the LMEs. They are relevant in that they highlight time series catches which indicate fisheries status and trends. Time series data are available online with University of British Columbia (UBC) Sea around us project, FAO and Fish base (Sumaila, Marsden, Watson & Pauly, 2007; Sherman & Hempel, 2008; IOC-UNESCO, 2011). The time series data as claimed do exist and are freely available online on the 'Sea-Around Us' project website via <http://www.searoundus.org/data/#/lme/28?chart=catch-chart&dimension=taxon&measure=tonnage>.

#### **3.6.5.2 The Value of reported landings**

The value of reported landings is another indicator for the fish and fishery module that is used to assign real economic value of catches in addition to being a cross modular indicator with strong links to the socio economic module indicator as well as a major stress factor in marine ecosystems. It is computed by using the catch value as the ex-value which is determined by the value of reported landings by LMEs based on real 2000 prices. Currently, a global time series (1950-2006) database for ex vessel fish price data has been constructed by Sumaila et al., 2007 and are presented by Sherman & Hempel (2008) (Sumaila, Marsden, Watson & Pauly, 2007; Sherman & Hempel, 2008; IOC-UNESCO, 2011). Time series data are available and easily accessible online on the 'Sea-Around Us' project website.

### **3.6.5.3 The Marine Trophic Index and Fish in Balance Index**

The marine trophic index and fish in balance index (MTI & FIB): an indicator for the fish and fishery module is developed and used for fish trophic levels which is recognised as the most accurate way of also observing stock depletion. Its methodology is derived from time series data from 1950-2006 of MTI and FIB where trophic levels are assigned to all catches per given area and is calculated by weighting the species/group with the corresponding catch level. This indicator indicates changes in the state of ecosystem and its provisioning services occasioned by fishing. Trophic levels data can be obtained from FAO based on the information on fish base and sea life base data bases as well as the UBC Sea around us project (Pauly et al., 1998; Pauly et al., 2000; Sherman & Hempel, 2008; IOC-UNESCO, 2011). While these sets of data exist in FAO and 'Sea Around Us' project; issues of integrity arise due to differences in species composition and the fragmentation of the data which might affect the weighting system (IOC-UNESCO, 2011).

### **3.6.5.4 The ecological footprints of fisheries**

The ecological footprints of fisheries is also an indicator from the fish and fishery module which is used in direct proportionality to the primary production required (PPR) and is estimated on the basis of trophic level catches. A fraction of total PPR in the LME from time series data (1950-2006) and landing data is used to estimate footprints as PPR is calculated separately for each species for the fleet of all countries operating in the LME in question. This is relevant as a strong indicator of fisheries sustainability. When related to an observed PPR provides another index for equally assessing impact of the countries fishing within an LME. Thereby making the assessment of combined footprints of different countries possible (Sherman & Hempel, 2008; IOC-UNESCO, 2011). This is computed based on estimation of available data as explained above, however issues of reliability (IOC-UNESCO, 2011) for a particular area might arise due to variability in species composition and issues of migratory stocks.

### **3.6.5.5 The stock status plots**

The stock status plots: an indicator within the fish and fishery module is used to determine stock exploitation status which can also guide towards achieving

sustainable yields. It is derived as a percentage of stocks of a given status and percentage of catches extracted from stocks of a given status by a given year. It is relevant in that it provides the fraction of the reported landings derived from stocks in various phases of development over series of years as opposed to ordinarily the number of such stocks. Data to be used are as contained in the time series fishery data with FAO and UBC Sea around us project and University of Kiel (Froese & Kesner-Reyes, 2002; Pauly et al., 2008; IOC-UNESCO, 2011). Initial investigation on the accessibility of this data revealed that it is computed from the reported landings as developed by Sumaila, Marsden, Watson & Pauly (2007) and it is strongly related to 'LME carrying capacity indicator' in addition to reported landings and value of reported landings.

#### **3.6.5.6 The fishing effort**

The fishing effort is another indicator for the fish and fishery module and is used to indicate the cost of fishing itself in relation to bottom habitat modification that is occasioned by fishing gear. Its methodology is computed globally through the expression of kilowatts days globally by continents, by countries, by vessel tonnage class and by vessel or gear types. Fishing effort has been recognised as the most important stressor presently in global LMEs. Presently, global efforts are continuing in developing a comprehensive and spatially explicit database for this indicator (IOC-UNESCO, 2011). This indicator will be developed before or during the full size project (FSP) of the TWAP assessment in future.

#### **3.6.5.7 The projected catch potential**

The projected catch potential is an indicator within the fish and fishery module is expected to be used to illustrate impacts of natural variability on ecosystem state and services thereby helping to prioritize climate change adaptation strategies. It is computed by projecting future changes in maximum catch potential by 2055 under two climate change scenarios based on the analysis of 1066 species of commercially exploited marine fish and vertebrates (Cheung et al., 2009). Its relevance is in its ability to project change or variation in maximum catch potential which could directly affect global food security and the relevant MDG and consequently lead to food and revenue losses for tropical countries. Although yet to be tested for LMEs;

it is believed that it could be structured to suite conditions for the global LMEs (Cheung et al., 2009; IOC-UNESCO, 2011). Data on this indicator is however incorporated within the TWAP methodology, but it is yet to be tested anywhere else.

#### **3.6.5.8 The LME carrying capacity in relation to Maximum Sustainable Yield (MSY)**

The LME carrying capacity in relation to maximum sustainable yield is the last among the TWAP fish and fishery module indicators and is used to observe changes under different environmental conditions as the ecosystem structure and processes change. It is usually computed either by use of fish biomass estimates in LMEs using the Ecopath with Ecosim modelling approach and software developed by Christensen et al., (2009) or by the concept of ecosystem carrying capacity ECC as adopted by some published SAPs for some of the LMEs such as the Yellow Sea which takes into account indicators from all the five LME modules (Sherman, 2014). It is recognised as a very important tool for the recovery and sustainability objectives for a degraded LME and the resultant information is presented as graphs, images and visuals (Christensen et al., 2009; IOC-UNESCO, 2011). Initial findings on the availability of this data revealed that the software is freely available and variables from data sets are converged to construct models for each of the global LMEs. This indicator is also strongly related to all the five modules for its ability to present an overarching ecosystem trends.

#### **3.6.6.0 The pollution and ecosystem health module indicator**

The pollution and ecosystem health module has eleven main TWAP indicators; namely the mercury contamination, plastic resin pellets, nutrients, negative trend in dissolved oxygen concentration, shipping density, harmful algal blooms HABs, freshwater discharge, sediment discharge, seamounts at risk, change in protected area coverage and change in extent of mangrove habitat.

##### **3.6.6.1 The mercury contamination**

Mercury contamination is used to portray the extent and significance of negative trend on human health in relation to the aquatic environment. Its methodology is computed through the correlation of inorganic mercury in matrices to production

and accumulation of organic mercury in the marine environment. Its relevance is due to its long range atmospheric transport and persistence in the environment once it is induced anthropogenically. Data and practice are only available for Europe, North America and Japan presently (UNEP, 2002; UNEP, 2008; IOC-UNESCO, 2011). There is no known currently reliable data on this indicator for most African LMEs as stated earlier.

### **3.6.6.2 The plastic resin pellets**

Plastic resin pellets is used as a result of their ability to absorb hydrophobic compounds such as Persistent Organic Pollutants (POPs) present in surrounding sea water with a very large concentration. Current methodology relies on a global network of volunteers and agencies that collect pellets from beaches and send them to a single laboratory in Tokyo for analysis. The concentration of pellets indicates variations in land use and industrial development in the adjoining coastal waters and catchments. Presently data exists in fragmented data sets from the laboratory in Japan (Ogata et al., 2009; Smedes et al., 2009; Lohmann & Muir, 2010; IOC-UNESCO, 2011). Attempts to look at the possibility of this data's existence revealed that the data exists, but fragmentally and is not easily accessible and as such is impracticable.

### **3.6.6.3 The nutrients indicator**

The nutrients indicator is used in determining nutrient over enrichment due to its high impact on the environment. It is computed through a spatially-explicit global watershed model (NEWS) that relates human natural processes in watersheds where dissolved inorganic nitrogen (DIN) load per LME could be aggregated. It is relevant because LMEs over enrichment have been well documented (Selman, Greenhalgh, Diaz & Sugg, 2008; Ogata et al., 2009; Smedes et al., 2009; Lohmann & Muir, 2010; Gilbert et al., 2010) globally as areas of nutrient loading with increase in frequency of occurrences. Although data exists for some regions in the form of maps and visuals, it is however yet to be included in any TWAP assessment but is expected to be included during the FSP (Seitzinger et al., 2005; IOC-UNESCO, 2011). This is one of the indicators expected to be fully developed during the FSP especially for TWAP LME and GEF funded projects.

#### **3.6.6.4 The negative trends in Dissolved Oxygen (DO) concentration**

The negative trends in dissolved oxygen concentration indicator highlights the linkages of hypoxic zones on the continental shelf to eutrophication. It is calculated as a proportion of all data series within an LME that portrays a negative trend in dissolved oxygen DO concentration based on time series data and measurements. Its relevance is because as DO depleted or hypoxic zones increase globally, they tend to have pronounced effects on marine communities and fisheries. Data exists with the Scientific Committee on Ocean Research SCOR but is not easily accessible (Gilbert et al., 2010; IOC-UNESCO, 2011).

#### **3.6.6.5 The shipping density**

The shipping density indicator is used to determine shipping traffic which is a dominant source of distant anthropogenic sound in the ocean that impacts on marine life within the marine ecosystem. Its methodology currently is via the estimation of ship-sourced inputs of some contaminants like tributyltin TBT and hydrocarbons as a function of ship traffic and is relevant as a result of being a significant source of categories of pollutants mentioned earlier and perhaps of some invasive species through ballast water discharges. Ship traffic data could be obtained for various time scales from the NOAA through its Voluntary Observing Ship (VOS) programme, GESAMP and IMO. While data exists with the source, there is however the need to further develop the indicator in FSP so as to integrate it with other fragmented data sets in order to obtain spatially referenced data on shipping traffic, ship size, ship type and flag state (IOC-UNESCO, 2011). This indicator can also be further developed by considering how invasive species are introduced through ballast water discharges from ships; as such collaboration with the IMO for the indicator development should be considered so as to make it all encompassing to truly measure shipping density.

#### **3.6.6.6 The Harmful Algal Bloom**

Harmful algal blooms (HABs) is an indicator for the pollution and ecosystem health module due to the threats it poses to ecosystem status. This is as HABs have been found to cause massive fish kills, contamination of seafood with toxins and

alteration of ecosystem health and services and in the process endangering health and livelihoods of dependents of this important ecosystem services. Methodology for computing this indicator is in the compilation of the HABs data by the IOC-UNESCO and other regional initiatives like the NOAA Harmful Algal Blooms Observing System (HABSOS) that hold data for the Gulf of Mexico and the GEF LME projects. This is in addition to a review of cataloguing systems susceptible to symptoms of eutrophication which provided a global map of hypoxia events (Selman, Greenhalgh, Diaz & Sugg, 2008; IOC-UNESCO, 2011). This indicator possesses strong links with fishery but the current fragmentation of the data set may bring up issues of integrity in addition to potential computational disparities.

#### **3.6.6.7 The fresh water discharge**

Freshwater discharge as an indicator is used to examine how human activity and climate change variability alter freshwater input to coastal and marine habitat. It is relevant since habitat alteration has serious consequences for the provisioning function of ecosystems as well as for the communities that depend on them. It uses the Global NEWS model for its methodology in similarity with the nutrient indicator methodology-which in itself is yet to be fully developed-although fragmented data exists for some of the GEF LME projects (IOC-UNESCO, 2011). When fully developed and the fragmented data aggregated this indicator might be very useful for monitoring the health of a marine ecosystem. It is also being considered for further development in the FSP.

#### **3.6.6.8 The sediment discharge**

Sediment discharge indicator is to determine the extent of sediment smothering on critical habitats like sea grasses and coral reefs. This is particularly important since human interference like dam construction and water diversions significantly alter sediment load to coastal waters thereby affecting ecosystems and their services. Its methodology and data availability status is similar to the nutrient and freshwater discharge indicators as outline above (IOC-UNESCO, 2011).

### **3.6.6.9 The seamounts at risk**

'Seamounts at risk indicator' is used to examine key areas for biodiversity in the ocean and supports a range of vulnerable habitats. It is computed by recording species in hydrothermal vents and cold seep locations in hydrothermally active and non-active seamounts. They are relevant for determining the threats posed by these conditions in addition to being targeted by destructive fishing practices like bottom trawling. A freely available global data layer exists which was compiled from multiple sources on the Seamounts Online website (IOC-UNESCO, 2011). The availability of this data proved difficult as the freely available online data appeared incomprehensive and fragmented.

### **3.6.6.10 The change in protected area**

Change in protected area coverage as an indicator is important in sustaining ecosystem health. The methodology is based on a global scale layer of data compiled by UNEP-WCMC from multiple data sources and the indicator itself is derived from the World Database on Protected Areas WDPA which is recognised as the most up to date globally for spatial data sets on marine and terrestrial protected areas. Data are fed into the WDPA from national governments or approved NGOs in varying formats and subsequently processed into standard GIS formats and made available online (IOC-UNESCO, 2011). The issue with this indicator is in the integrity of the datasets since they are from a variety of sources that may not be independently verified and are not peer-reviewed as the methodologies from the contributors are not clearly defined.

### **3.6.6.11 The change in extent of mangrove habitat**

'Change in extent of mangrove habitat' is an indicator used to examine mangrove cover which has been recognised as key to success of biodiversity targets since mangroves are under threat from anthropogenic climate change. It has a similar methodology to the 'Change in protected area coverage' indicator and is extremely valuable in terms of maintaining ecosystem services. A global data layer exists but for very limited locations (IOC-UNESCO, 2011).

### **3.6.7.0 The socioeconomic module indicator**

The socio economic module is based on some policy assumptions. These are (1) increase in capital within sustainable levels in terms of social capital, human capital, natural capital, physical capital and financial capital as indices (2) reduction in vulnerability to natural disasters, to disease and to economic fluctuation as indices (3) enhancement of wellbeing through universal education, gender equality, reduction of child mortality and improvements in maternal health as indices (Sutinen, 2000; Olsen, Sutinen, Juda, Hennessey & Grigalunas, 2006; McGillivray & Noorbakhsh, 2004; Hoagland & Jin, 2008).

For benefits derivable from ecosystem perspective; they have been streamlined for TWAP purposes into four measurable indicators, namely GDP fisheries, human development index HDI, deaths per 100000 caused by climate change related disasters and marginal economic value (MEV).

#### **3.6.7.1 The GDP fisheries**

GDP fisheries as an indicator is useful for measuring the value achievable from fisheries per given nation and per two nations in a shared system and is computed as the value of fishery output-nominally in a given year per nation or two nations in a shared system while real GDP measures the same in two or more years. This is relevant for measuring dependence or reliance on fisheries provisioning services among the ecosystem services. Data is available with FAO FishStat per any given nation (UNEP, 2011; IOC-UNESCO, 2011). Investigation into this data revealed that although it is not freely available, it is obtainable on request from FAO.

#### **3.6.7.2 Human Development Index (HDI)**

The human development index is used for identifying level of livelihood derived from fishery ecosystem provisioning services and is computed as composite of life expectancy at birth, adult literacy rate and per capita GDP. This could also be relevant as a relevant example of an index comprising of three indicators and data is available for any given nation with World Development Indicators WDI and FAO (UNEP, 2011). Data on this indicator is freely available and easily accessible.

### **3.6.7.3 Deaths per 100000 caused by climate related disasters**

'Deaths per 100000 caused by climate related disasters' is used to indicate how natural disasters affect humans and is assumed to be based on natural occurrences. Relevant for examining climate change impacts on humans and ecosystems. Data is available nationally from censuses, FAO, WDI and climate risk index per any given nation (UNEP, 2011). Data on this indicator may also be collected nationally from individual nations' population agencies.

### **3.6.7.4 Marginal Economic Value**

Marginal Economic Value (MEV) is an indicator that identifies services/impacts on the ecosystem services by e.g. destruction of habitats. Its methodology is computed as the additional value gained or lost by a change in provision of flow or in a level of stock. This is recognised as also being more relevant to policy making because decisions involve incremental changes in ecosystem provisioning services. A demonstration project is currently being developed through the Southeast Pacific Action Plan through the UNEP Regional Seas Programme, McGill University, UN Economic Commission for Latin America and the Caribbean and the Andean Development Bank (IOC-UNESCO, 2011).

Currently data exists for some developed nations and in the process of being developed globally (Barbier et al., 2009; IOC-UNESCO, 2011). The indicator may be useful for the research area when fully developed.

## **3.7 The governance module indicator**

The governance module addresses the issue of governance through some four orders of outcomes (1st order-Enabling conditions, 2nd order-Changed behaviour, 3rd order-Attainment of LME goals, 4th order-Sustainable LME conditions and uses). They were to be determined in two stages and they are the LME governance architecture and performance of governance arrangements. The stage 1 is developed and proposed while the stage 2 is expected to be implemented during or after the FSP when suites of other modules together with steps taken for stage1 must have been properly tested (IOC-UNESCO, 2011).

The LME governance architecture requires five steps to determine the level of governance for each of the water systems, namely; identify system to be governed, identify issues to be governed, identify arrangements for each issue, identify clustering of arrangements within institutions and identify links. Guidance in the form of some 'key points' for each step was also developed to help in formulating the architecture (Mahon, Fanning & McConney, 2010; Mahon, Fanning, McConney & Pollnac, 2010; IOC-UNESCO, 2011).

These issues were addressed through the use of interviews and questionnaires employed from the survey and elicited responses from the officials responsible for managing the transboundary resources (JDA) as well as other relevant stakeholders; responses and results would then be expected to contribute to the development of specific and generic indicators for the transboundary 'hotspots' or areas of sub-LME scale such as the research area and may contribute to the literature for consideration during the FSP in the near future (IOC-UNESCO, 2011).

### **3.8 Trends in indicators deployment for marine fishery resources: Global perspectives**

While there are quite a number of examples of the deployment of indicators (Higgins, 1991; Charles, 1997; Dahl, 2000; Buuren et al., 2002; Henocque, 2003; Potts, 2006; Kestemont, Frendo & Zaccai, 2011) , only a few are actually adopted in policy formulation processes and these few are largely concentrated in Europe and Australia and some even fewer examples (Scheren et al., 2002; Ukwe et al., 2003; Ukwe et al., 2006) in the Gulf of Guinea. Even these examples however are on single state evaluation as opposed to a joint or shared assessment as will be divulged below.

The issue of the use and implementation of indicators in the policy process remains a significant challenge depicting an uneven distribution of implementation arrangements across various governance jurisdictions. This has been observed to be as a result of lack of data within the fishery sector generally in addition to absence of clearly defined roles (Potts, 2006).

Some scholars such as Thebaud, (1997); Chukwuone et al., (2009); Scheren et al., (2002); Ukwe et al., (2003) and Ukwe et al., (2006) have extensively studied transboundary marine resources and some particularly in the Gulf of Guinea. What they have not done is to evaluate indicators to examine their effectiveness and applicability in a joint development context vulnerable to IUU fishing prevalence.

A number of studies from across the globe, inter alia Buuren et al., (2002); MRAG et al., (2009); Himes, (2005); Henocque, (2003) and Kestemont, Frendo & Zaccai, (2011) focused on testing the applicability of indicators and rights based management through the use of case studies involving qualitative inquiries. Others such as Ehler, (2003); Juda & Hennessey, (2001); Olsen, (2003) and Olsen et al., (2006) have extensively worked on indicators' performance in relation to governance using similar methodology and proposed compliance to indicators' application.

Others such as Ramos & Caeiro, (2010) have highlighted the non-inclusion of indicator performance measurements in measuring sustainability and suggested the use of case studies involving stakeholders to properly evaluate sustainability indicators. Their approach however was limited to a single state evaluation as opposed to a shared resource sustainability assessment in a joint development arrangement vulnerable to IUU fishing and devoid of strong institutional frameworks.

While this may have been an important gap in the indicator employment literature, there is equally in addition to this, a lack of an evaluation and monitoring framework on how indicators are used and the application of the lessons learnt by practitioners has also been identified as a very strong challenge by Lyytimaki & Rosenstrom, (2007) when they suggested such studies for future research.

Table 3.2 provides a summary of some of the key literatures examined while the following sections will highlight some examples of applications from the EU, Australia and the Gulf of Guinea.

Table 3.2-Summary of key literature examined

(Source: Author's own)

Author(s)	Year	Focus	Coverage
<b>Potts, T.</b>	2006	Proposed the sustainability indicator system (SIS) as framework for the analysis of sustainability indicators in fisheries	Applied to the Australian Commonwealth Sustainable Fisheries Assessments and the Marine Stewardship Council
<b>Dahl, A.</b>	2000		
<b>Garcia, Staples &amp; Chesson</b>	2000		
<b>Charles, A.</b>	1997		
<b>Higgins, J.</b>	1991		
<b>Rice &amp; Rochet</b>	2005	Framework for indicator-based decision making capable of providing structured insight to resource managers	Comprises of eight steps for objective selection of a suite of indicators with great emphasis on stakeholder participation
<b>Thebaud, O.</b>	1997	Use of bio economic model improved the analysis of transboundary impacts of harvesting but highlighted the uncertainties on the dynamics of transboundary fisheries.	Based on the complex interrelationships inherent in fisheries regulation prior to UNCLOS and the institutional frameworks that came into being as a result of coming into force of UNCLOS
<b>Chukwuone et al.</b>	2009	Estimated the values of direct output impacts of the GCLME goods as well as pollution abatement strategies. Also called for properly defined property rights in addition to embracing the LME approach	The entire GCLME covering the EEZ of sixteen countries; from Guinea-Bissau to Gabon and Angola
<b>Scheren et al.</b>	2002		
<b>Ukwe et al.</b>	2003		
<b>Ukwe et al.</b>	2006		
<b>Buuren et al.</b>	2002	Testing the applicability of indicators as well as rights based management (RBM) through the use of case studies	Ranging from units within nations and on some national schemes for the indicators and some cross national applications for RBMs
<b>MRAG et al.</b>	2009		
<b>Himes, A.</b>	2005		
<b>Henocque, Y.</b>	2003		
<b>Kestemont, Frenedo &amp; Zaccai</b>	2011		
<b>Ehler, C.</b>	2003	Governance issues and performance indicators in measuring sustainability	Global application of Governance arrangements and emphasis on stakeholder engagement as essential
<b>Juda &amp; Hennessey</b>	2001		
<b>Olsen, S.</b>	2003		
<b>Olsen et al.</b>	2006		
<b>Ramos &amp; Caeiro</b>	2010		

Based on the examples identified in Table 3.2 and the fact that the deployment of indicators in the policy process is only gaining momentum even among the developed countries as shown in this section; some key examples from the EU, Australia and the Gulf of Guinea will be subsequently highlighted in Sections 3.8.1 to 3.8.3.

### **3.8.1 The European Union**

There are several examples of the application of marine indicators in various EU countries. In considering their application collectively however, an example of how they are reported by the European Environment Agency (EEA) will be highlighted.

In the EEA, it is imperative to recognise that the main objective of the Agency as far as marine indicators are concerned is to spearhead the reporting of indicators as they relate to the development of a core set of indicators rather than conducting assessments (Buuren et al., 2002).

The EEA as an environmental regulator for the EU countries' individual environment agencies play a significant role in the coordination between all EU countries. It does this by coordinating the uniform reporting on data availability and trends in various indicators deployment on behalf of the EU as a regional entity leaving the assessments to individual countries environment agencies (Buuren et al., 2002).

A review of recent applications in the EU depict linking various ecosystems provisioning services to a number of candidate indicators randomly selected (based on preference) in order to quantify the provisioning services of the marine ecosystem. This has been found to be in line with the framework for distinguishing ecosystems services, processes, values and its benefits. It has also been posited to be in conformity with a typology known as The Economics of Ecosystems and Biodiversity framework; which is believed to simplify the process of incorporating ecosystems based management into marine spatial planning (Henrichs, Baulcomb, Koss, Hussain & de Groot, 2013).

### **3.8.2 Australia**

In Australia also, there have been several examples where marine indicators have been deployed depending on the resources or the sector being considered.

One example is the development of the guidelines for implementing the sustainability indicators for marine capture fisheries. The guidelines were developed by Australia in conjunction with the Food and Agriculture Organisation (FAO) of the UN and consisted mainly of five steps to serve as the basis of

Sustainable Development and Reference System (SDRS). The steps include specifying the scope to be adopted by the SDRS; framework for the adoption of the components; specifying the criteria, objectives, candidate indicators and their values; selecting the set of appropriate indicators and finally specification of the visualisation and aggregation methods (Garcia, Staples & Chesson, 2000).

The development of each candidate indicator varies however among individual fishing sectors. As a result differences manifest because of the adoption of each fishery separately as the basic component unit for the SDRS in various jurisdictions such as the Federal and State levels. This empowers individual jurisdictions with the powers to implement critical management decisions which in turn makes distinguishing between human impacts on the marine environment and the fishing impact on the human population clear and easy (Garcia, Staples & Chesson, 2000).

### **3.8.3 The Gulf of Guinea**

The UN called for the use and deployment of indicators for marine resource sustainability assessments and they subsequently offered assistance through the Global Environment Facility for conduct of LME assessments in some selected LMEs including the Guinea Current Large Marine Ecosystem. This is arguably the first concrete step taken by the Gulf of Guinea countries to edge towards the use and deployment of indicators for marine resource sustainability and assessment.

As observed in Sections 3.2 and 3.3 the sixteen countries of the region participated in the GEF-funded assessment which formed one of the basis for the development of methodology and arrangements for the TWAP LME indicators that were published in 2011 by the IOC-UNESCO (IOC-UNESCO, 2011; Pernetta & Bewers, 2012).

One of the most important outputs of that assessment was the development and production of the Transboundary Diagnostic Analysis (TDA) for the Gulf of Guinea and other LMEs and the subsequent adoption of the procedures employed for replication in other LMEs in future (IOC-UNESCO, 2011; Pernetta & Bewers, 2012).

The TDA identified issues, problems and threats to all the participating LMEs. The four main threats identified for the Guinea Current are (1) the decline in GCLME fish stocks and unsustainable harvesting of living resources (2) the loss of ecosystem integrity (3) Deterioration in water quality (4) Habitat destruction and alteration (IOC-UNESCO, 2011; Pernetta & Bewers, 2012).

It should be noted that currently there exists no globally acceptable detailed methodology for the assessment of a transboundary water body vulnerable to IUU fishing such as the research area-JDZ (IOC-UNESCO, 2011). It is an area within an LME but smaller in size than the typically defined LME. Within the Medium Sized Project (MSP) Transboundary Waters Assessment Programme (TWAP) Large Marine Ecosystem (LME) methodology recently published, this kind of area is referred to as an area of 'sub-LME' scale. Their development is being considered for the Full Size Project FSP in future (Alder & Pauly, 2008; IOC-UNESCO, 2011).

### **3.9 The need for specific sub-LME indicators for the assessment of transboundary hotspots or areas of sub-LME scale**

Despite broader research and assessments globally that are directed towards the overall ecosystem based management of marine resources including, inter alia, Global Environment Facility Large Marine Ecosystem projects, Global Environment Outlook, Regional Seas Programmes, Global International Waters Assessment and Integrated Coastal Management initiatives (Bensted-Smith & Kirkman, 2010), none among them effectively tackled transboundary water concerns using the GEF LME Transboundary Waters Assessment Programme TWAP with its assessment methodologies. Emphases have always been on the legal and bio geographic instruments (Miyoshi, 1988; Wang, 2004; Kimball, 2005; IOC-UNESCO, 2011).

However, even the TWAP LME has recognised the lack of a specific sub-LME assessment framework when it earmarked it for the future in the recently published TWAP LME methodology (IOC-UNESCO, 2011).

In addition to this, a lack of an evaluation and monitoring framework on how indicators are used and the application of the lessons learnt by practitioners has also been identified as a very strong challenge by Lyytimaki & Rosenstrom (2007) as

observed in Section 3.8 when they suggested such studies for future research. This would be particularly relevant to the research area considering the limitations of stakeholders and the remoteness of its location in addition to the series of events leading to its formulation in the first place.

As such, specific sub-LME indicators are needed to make assessments of areas similar to the research area and other joint development areas or hotspots as identified by IOC-UNESCO, (2011).

### **3.10 The concept of Joint Development arrangement for marine resources management**

The concept of joint development arrangement over marine resources between and among adjoining coastal states has been around since the 1930s. However under different connotations and arrangements from what is recognised currently (Miyoshi, 1988; Garcia & Hayashi, 2000). This is because sufficient attention to formalise cooperation has not been made as clear as it is today as a result of UNCLOS (Garcia & Hayashi, 2000).

#### **3.10.1 Understanding Joint Development of transboundary marine resources**

Cooperation under a joint development regime has been identified as one of the most viable options in the settlement of a disputed or overlapping claim over transboundary resources. While a number of joint development arrangements exist globally with many of them in existence over offshore marine energy resources only a few cover all the marine resources within a disputed region such as the Nigeria-Sao Tome & Principe JDZ (Garcia & Hayashi, 2000; Joyner, 2000; Wang, 2004).

#### **3.10.2 Historical evolution of Joint Development arrangements**

The idea of the 'joint development' of resources across boundary lines or within the areas of territorial jurisdiction of a State has been around since the 1930s. Prior to the delimitation of the boundary lines under UNCLOS, the joint development schemes were of two types; one that does not uphold boundary delimitation and the other that upholds the boundary delimitation (Miyoshi, 1988).

The pre-UNCLOS arrangements did not consider the boundary delimitation in their arrangements and lines were largely arbitrarily drawn just to serve the purpose for which the arrangements were drawn up for. This is because the idea in itself was not in the parlance of international adjudication during the period and the International Court of Justice only incorporated its use in 1969 during the verdict on continental shelf cases involving The Netherlands and Germany (Miyoshi, 1988).

The post-UNCLOS arrangements encompassed boundary delimitations in line with the provisions of UNCLOS when nation states' EEZ were delineated and several adjudications came to the fore between various coastal nations in their desire to delineate their maritime boundaries and establish the extent of their EEZ (Miyoshi, 1988). It is this arrangement that recognises several fragmentations and uses of the seas and in the process clearly defined individual coastal States' rights over their coastal and marine resources as well as rights of innocent passage by other user nations.

### **3.10.3 Institutional and legal frameworks for Joint Development of marine resources**

While institutional and legal arrangements exist for managing resources under a joint development arrangement, some of the most documented cases (Miyoshi, 1998; Oduntan, 2008) arose as a result of the need to manage marine minerals such as hydrocarbons. The frameworks for the management of the living resources are largely found in the provision of international instruments such as Chapter 17, Agenda 21 of the 1992 UNCED and the 1982 UNCLOS for marine living resources.

In Africa for example, legislation is proclaimed either as a response to a particular issue or as a remedy. Arguably this is why most of the countries in the Gulf of Guinea have environmental protection legislation such as the Environmental Impact Assessment Decree No.86 of 1992 in Nigeria and the Environmental Law No.7 of 2003 with its amendments for Equatorial Guinea. Similarly, section XII of UNCLOS general provisions made it an obligation for a coastal state to protect and preserve its marine environment through the adaptation of measures for the preservation, reduction and controlling of any form of pollution. The coastal state can also

institute legal proceedings which may include detention of the vessel concerned when oil discharge causes major damage or threat to its marine environment, territorial sea or coastline (Akohou, 2008).

When the delimitation of maritime boundaries is done, the exercise of the sovereign rights as well as the exclusive jurisdiction for coastal states in their EEZ and continental shelf as contained in Articles 60,76,77,80 and 81 of UNCLOS is what the legal framework for offshore oil and gas exploration and production within the Gulf of Guinea is based upon. Rights which must not infringe on the rights of other states and sovereignty over the continental shelf of the coastal state does not interfere with the legal status of the super adjacent waters and the air space over and above those waters (Akohou, 2008). An illustration of oceans’ legal regime is depicted in Figure 3.1:

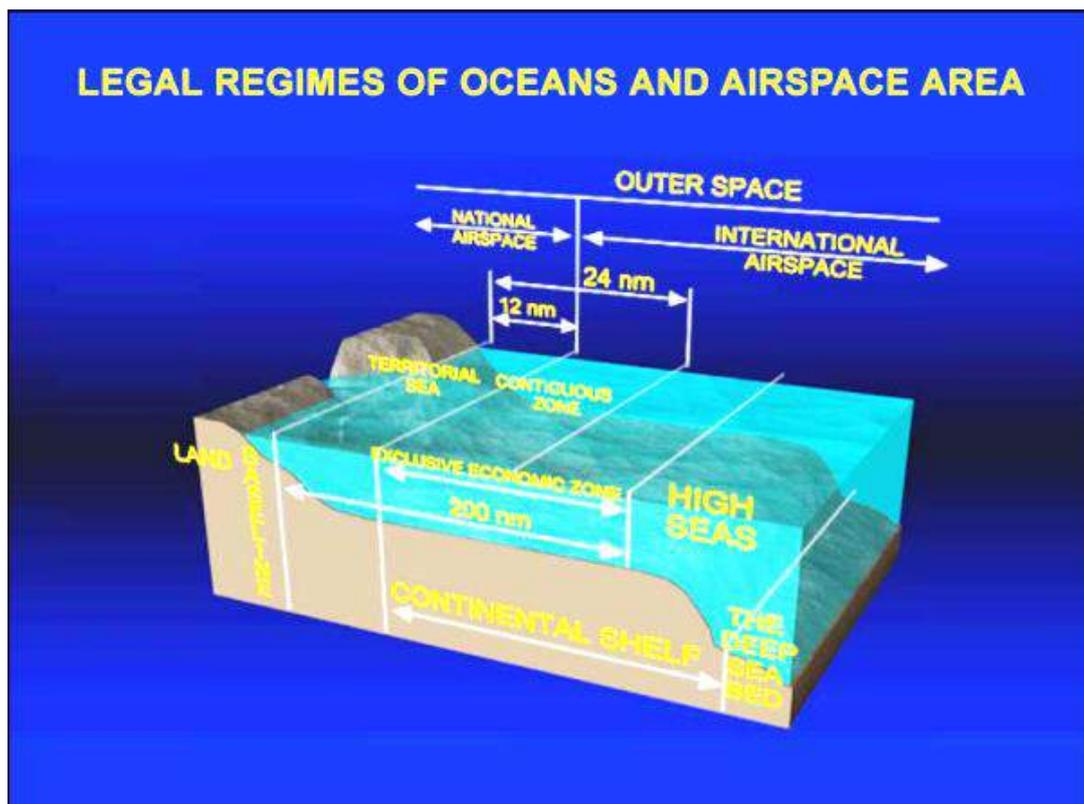


Figure 3.1 Ocean’s legal regime (Source: Schofield, ND.)

In the 1950s and 1960s, oil and gas exploration and production were governed by concessions granted to consortiums with a regime based on the sovereignty principle of a state exercising exclusive control over resources. This made each oil and gas model contract unique in regions such as the Gulf of Guinea because

Production Sharing Contracts are carried out individually and at varying times by separate states (Bonney, 2006).

### **3.11 Managing marine resources in a disputed area**

The process of establishing a mutually acceptable maritime boundary or boundaries between and among two or more disputing States is usually a very difficult, slow and challenging exercise (Churchill & Ulfstein, 1992; Uitto & Duda, 2002). While ensuring a sound and acceptable management regime for the resource in contention is equally usually difficult and often filled with mistrust among parties (Churchill & Ulfstein, 1992; Uche-Okeke, 2008).

However, States that are in dispute over territories have often been encouraged to enter into a sort of joint development arrangement over the disputed resources with a view to shelving the disputes and adopting cooperation (UN, 2001; Umar, 2002). This is because the joint development arrangement has become the most practical and acceptable way of dealing with deadlocks encountered during negotiations over disputed territories and maritime boundary lines (Miyoshi, 1988; Churchill & Ulfstein, 1992; Garcia & Hayashi, 2000; Joyner, 2000; UN, 2001; Kimball, 2005). Several cases such as the examples in Sections 3.11.1 to 3.11.6 around the world exist on such arrangements. While the majority of the joint development arrangements are over marine minerals usually oil and gas, there are some that are mainly on marine living resources or a combination of both (Wang, ND.).

The following cases are some of the key joint development arrangements between nation States over disputed cross-border resources similar to the situation in areas such as in the research area.

#### **3.11.1 The Anglo-Norwegian Joint Development arrangement**

While the dispute that prompted the idea of a joint development arrangement between the UK and Norway may have its foundations in fishing rights issues since the early 1930s, the main arrangement which was agreed to by the two nations was over marine minerals, mainly offshore hydrocarbons. The initial agreement took place in 1965 which enabled them to lay the foundation for unitization in line with international law principles (Wang, ND; Umar, 2002; Uche-Okeke, 2008).

By explicitly providing the clause for cooperation between two nations upon the discovery of petroleum deposits, the Anglo-Norwegian arrangement set a very important precedence not only on subsequent North Sea cases but for international law in general and the Nigeria-Sao Tome & Principe Joint Development arrangement in particular.

### **3.11.2 The Norwegian-Russian Joint Commission on fisheries**

The arrangement between Norway and Russia over their maritime boundary predates UNCLOS III as they signed an agreement establishing their maritime boundary as early as 1957 although neither of the two nations possessed any maritime zone at that time (Churchill & Ulfstein, 1992). It was an agreement that was earmarked to 'follow a straight line' from the terminus of their land frontier to the intersection of the outer limits of the two nations' territorial waters (UN, 2001). This agreement was to later prove to be a source of tension with the coming of UNCLOS as it was contrary to the provisions of the agreement for any of the two nations to lay claim to its either continental shelf or EEZ beyond the agreed 'straight line' (Churchill & Ulfstein, 1992).

This led to the two countries entering into a joint arrangement in 1976 to manage common fisheries such as cod, haddock and capelin in the Barents Sea. They established a Joint Commission to oversee this and charged the Commission with powers to be involved in other aspects of fisheries regulation (Churchill & Ulfstein, 1992). From 1993, issues of fisheries and its regulation became one of the most important dimensions of the bilateral management arrangement.

### **3.11.3 The Columbia-Jamaica Joint Development Zone**

In 1993 while establishing their respective EEZs, Colombia and Jamaica agreed to set up a joint development arrangement through a treaty over an area that is approximately 4,500 square kilometres and designated it a 'Joint Regime Area'.

The Treaty, was established for the purposes of 'joint management, control, exploitation and exploitation of both the living and non-living resources' of the area it covers 'pending the determination of jurisdictional limits of each Party' in the spirit of cooperation as enshrined in the Law of the Sea convention. It also covered

issues such as the preservation of the marine environment and resources of the seabed, its subsoil and all other activities connected therefrom (Wang, ND.).

#### **3.11.4 The Barbados-Guyana Cooperative Zone**

The arrangement between Barbados and Guyana was established in December, 2003 and as a consequence created a 'Cooperative Zone'. It also agreed on establishing a joint administrative jurisdiction over the cooperative zone in line with the provisions of UNCLOS. It vested the control over the fisheries resources in a Joint Fisheries Licencing Authority and provisions are enforced on both sides of the two nations in line with their individual national laws. One of the high points of the treaty is the unlimited validity period it enjoys when it stated that 'It shall remain in force until an international maritime delimitation agreement is concluded between the Parties' without recourse to specifying a particular time frame (Wang, ND.)pg. 8

#### **3.11.5 The Senegal-Guinea Bissau Joint Development Zone**

In October, 1993, Senegal and Guinea Bissau became the first country in West Africa to establish a Joint Development Zone following the signing of a Bilateral Management and Cooperation Agreement. The agreement was later supplemented by a Protocol Relating to the Organisation and Operation of the Agency for Management and Cooperation that was signed in June, 1995 (Wang, ND).

This created an Enterprise under the direct supervision of their two Heads of States or any persons delegated by them and vested with the authority to manage their joint resources on behalf of the two States. The treaty also covers both living and non-living resources and it has a sharing ratio of 85:15 in favour of Senegal. In terms of the applicable law, the Senegalese Law prevails in areas of oil exploration and production while the Guinea Bissau Law prevails in areas of marine living resources such as fisheries (Wang, ND.).

#### **3.11.6 The Nigeria-Sao Tome & Principe Joint Development Zone**

In 1999, the officials of the Nigeria's and Sao Tome & Principe's governments embarked upon delineating their maritime boundary. They found that the two

nations' maritime boundary overlapped as a result of establishing their Exclusive Economic Zones (EEZ).

The existence of a considerable overlap between the territorial claims of the two countries over their respective maritime boundaries brought about the need for boundary negotiation for settlement. The Nigeria's EEZ law of 1978 was based on the principle of median line and modified in 1998 by decree No.41; while the Democratic Republic of Sao Tome and Principe had its 'Official Maritime Claims' law ratified and the two countries deposited their instruments at the United Nations in March 1998 on failing to arrive at a consensus (Umar, 2002).

The Nigeria-Sao Tome JDZ is an area agreed and delineated within the Guinea Current Large Marine Ecosystem (GCLME) along the Gulf of Guinea by the two nations as a result of overlapping territorial claims in establishing their Exclusive Economic Zones (EEZ).

The delineation of the area led to the signing of a joint development treaty in 2001- valid for 45 years and subject to review after 30 years- for the joint exploration of these resources on a 60/40 percentage ratio in favour of Nigeria. The JDZ area is approximately 34,450 square kilometres as shown in figure 2 (Umar, 2002).

As a consequence, the signing of the treaty led to the formation of the Joint Development Authority (JDA) as a sole management institution charged with the responsibility of managing the resources of the JDZ on behalf of the two states.

However, illegal, unregulated and unreported fishing is one of the most significant threats to the Gulf of Guinea in general with its attendant consequences of denying valuable and much needed revenues to the developing countries of the region.

### **3.12 Challenges of Illegal, Unregulated and Unreported fishing to marine fisheries**

It is generally believed (Bray, 2000; FAO, 2001; Sumaila, Alder & Keith, 2006; Falaye, 2008; Srinivasan, Watson & Sumaila, 2012; Polacheck, 2012; Osterblom & Bodin, 2012) that one of the most potent threats to marine capture fisheries globally is the one from IUU fishing. Several scholars (Falaye, 2008; Srinivasan, Watson & Sumaila,

2012) estimate global fishery losses due to IUU fishing to be in the range of billions of dollars per annum and this has been particularly devastating especially to developing countries. A majority of livelihoods in most coastal developing countries depend on fisheries for their survival both in terms of income and nutrition (Falaye, 2008).

### **3.12.1 Illegal, Unregulated and Unreported (IUU) Fishing**

The FAO, (2001) defined illegal fishing as that undertaken by vessels belonging to countries that may be a party to a fisheries organisation but operating in violation of its rules or without permission or operating on the high seas without identification by a flag or any other markings.

It further defined unreported catches as catches that are not reported to relevant authorities by fishing vessels or a flag state whether or not they are parties to the relevant fisheries organisation or its conventions (FAO, 2001). Sumaila, Alder & Keith, (2006) included misreported and underreported catches to this category.

The FAO, (2001) also defined unregulated fishing as a fishing that is done by vessels that fly the flag of countries that are not parties to or participants to the relevant fisheries organisation and which cannot then be bound by its rules (Sumaila, Alder & Keith, 2006).

### **3.12.2 IUU fishing prevalence around the Gulf of Guinea**

The waters off the coast of West Africa are among the world's richest in terms of fishery resources such as finfish, crustaceans and molluscs while its fishing communities are among the most impoverished and thus vulnerable to IUU fishing by foreign fleets (Duda & Sherman, 2002; Scheren et al., 2002; Falaye, 2008; Chukwuone et al., 2009).

It has been reported that Chinese and Korean vessels spend weeks plundering the seas off the Atlantic coast; they do so by capitalising on the lax policing situation and in pursuit of land shrimp, lobster and snapper worth \$10,000 per boat per day; while estimate of IUU fish loss per boat per year has been put at \$3,000,000 in the sub-region (Falaye, 2008).

### **3.12.3 Curbing IUU fishing**

The 2001 Food and Agriculture Organisation (FAO) International Plan of Action to Prevent, Deter and Eliminate IUU Fishing (IPOA-IUU) called on nation States to as a matter of interest take measures to ensure that all citizens and other users that are or may be subject to their jurisdiction do not support, encourage or engage in IUU fishing.

In observing this, nation States are encouraged to cooperate in identifying and prosecution of all those that are found to flout these rules, their collaborators and potential beneficiaries involved or engaged in IUU fishing. When caught, sanctions should be sufficient enough to deter others from wanting to engage and they should include range of punitive measures ranging from monetary fines, confiscation of fishing vessels and fishing gear to outright denial of future fishing licences to such category of offenders (FAO, 2001; Erceg, 2006; Falaye, 2008).

### **3.12.4 How alternative fisheries management schemes are used to curb IUU fishing**

One of the responses to sustainability concerns in terms of transboundary resources is the adoption of UNCLOS in 1982 and the subsequent 1995 UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks. This ushered in and strengthened the principles of ecosystem based management in addition to prevention of IUU fishing (Garcia & Hayashi, 2000; Thorpe et al., ND). This is in addition to the introduction of some regulated fishery management schemes being tested and adopted in some developed countries such as the UK and some EU countries (Branch, 2009; Chu, 2009; Douvere & Ehler, 2009; Sumaila, 2010).

The emergence of UNCLOS has brought about some stability into the issue of marine environmental resources apportionment within the global oceans lately. However, because of the nature of the seamless flow of both seawater and its living resources contained therein, it is natural that those resources do not respect boundaries or any lines drawn in the sea for the purposes of demarcation or ascertaining control (Hayashi, 1995; Garcia & Hayashi, 2000). As such, living

resources of the oceans faced another fresh threat to their management as a result of their transboundary nature.

Under the Common Fisheries Policy (CFP); one of the ways by which EU single states' and transboundary fisheries are managed is the use of Individual Transferable Quotas (ITQs) over time-a type of rights based management instrument. ITQs are a form of catch share which could be defined as tools employed by some governments in order to regulate or solve economic and biological problems arising from fisheries through exerting output rather than the traditional input controls (Gibbs, 2007; Branch, 2009; MRAG et al, 2009; Sumaila, 2010).

ITQs have been successfully employed to manage fisheries for over thirty years to attain resource sustainability, ensure adherence to total allowable catch (TAC), maintain discard levels, cushion the impacts of illegal fishing and help to maintain regulation and enforcement around many global fisheries (Grafton, 1996; Branch, 2009; Chu, 2009).

There is a considerable body of literature and expertise on fisheries management globally which presents lessons and alternatives for the management of fisheries within the JDZ. However, the European experience with schemes such as the individual transferable quotas (ITQs) possesses potentials for curbing the IUU fishing and transboundary stocks issues (Gibbs, 2007; Branch, 2009; Sumaila, 2010). Below are examples of just some of the few typologies depicted in Table 3c:

Table 3.3-Typology of fishery management approaches (Source: Author’s own)

Some approaches to fisheries management	Applications	References
<ul style="list-style-type: none"> <li>• Ecosystem approaches</li> <li>• Subsistence Approaches</li> <li>• Individual Transferable Quotas</li> <li>• Individual Vessel Quotas</li> <li>• Total Allowable Catch</li> <li>• Quota Auction</li> <li>• Special Fishing Permits</li> <li>• T.U.R.F.</li> </ul>	<ul style="list-style-type: none"> <li>• Many</li> <li>• Mainly Rural</li>   <li>• EU, US and Others</li>   <li>• EU, US and Others</li> <li>• EU, US and Others</li> <li>• Estonia and New Zealand</li> <li>• France and other EU</li> <li>• EU</li> </ul>	<ul style="list-style-type: none"> <li>• Gibbs, 2007</li>   <li>• Sherman et al., 2009</li>   <li>• Branch, 2009</li>   <li>• MRAG et al., 2009</li>   <li>• Sumaila, 2010</li> </ul>

### 3.13 Summary

Chapter three examined the practical aspects of managing marine resources generally drawing from the literature issues that prevail within the realm of marine resources management paradigm.

Section 3.2 examined marine resource management from an ecosystem perspective, the DPSIR component of the EBM and some examples of how EBM practices are carried out-the current stage of EBM approaches from best practices.

Section 3.3 examined the application of ecosystem based fisheries management practices from the Gulf of Guinea while Section 3.4 dwelt on the characteristics of small islands developing state due to its relevance as one of the two states sharing the resource is a small island developing state. Sections 3.5 and 3.6 examined trends in transboundary LME management issues and the evolution of indicators of marine resource sustainability respectively.

Sections 3.6.2, 3.6.3, 3.6.4 and 3.7 examined the typology and examples of relevant indicators and subsequently evaluated the details of the most relevant groups of indicators to the research. Sections 3.8, 3.8.1, 3.8.2 and 3.8.3 examined the current trend in the deployment of the indicators from global perspective highlighting

examples from the EU, Australia and the Gulf of Guinea. This is in addition to observing the lack of specific sub-LME assessment initiative and its indicators.

Section 3.9 subsequently highlighted the justification and the need for specific sub-LME indicators for the assessment and management of transboundary water concerns such as the research area. Section 3.10 to 3.10.3 examined the concept of joint development arrangement over shared marine resources while Section 3.11 to 3.11.6 examined the concept of managing marine resources in a disputed area and some key examples of such arrangements.

Section 3.12 to 3.12.4 examined the challenges of IUU fishing, its prevalence around the gulf of Guinea and how it might be curbed, this in addition to highlighting some alternative fishery management schemes that may be employed to curb the menace of the IUU fishing. Section 3.13 finally summarises the chapter.

## **Chapter Four: The Case Study approach**

### **4.1 Introduction**

This chapter will examine the adopted research design which is based on a case study approach by identifying the classifications of the approach, its advantages and disadvantages. It will also explore the theoretical bases of the survey methods employed for the research, namely; the use of interviews and questionnaires surveys.

It will further evaluate the processes and procedures followed in the development and construction of the survey questions as well as their composition into themes with a view to placing them into a context reflective of the research questions. This will be in addition to narrating the processes and procedures involved in the identification and choice of the stakeholders (survey participants) to which the survey was administered.

### **4.2 Classification of the case study approach**

Case study research has been defined as the research approach that attempts to study a situation in great detail, avoids generalisation (Thomas, 2011), substantiates assumptions or interpretations determined from incidences outside the laboratory setting while concurrently retaining the findings within laboratory science (Yin, 1997).

It has also been defined as an empirical enquiry which scrutinises a contemporary phenomenon within its real-life context, especially where the boundaries between phenomena and context are not very clear and definite (Yin, 2003).

The use of a case study research approach has been found to be the strongest option from among various research approaches when 'how' or 'why' questions are involved and when the researcher has little or no control over events prompting the study (Yin, 2003). As the research aimed at evaluating the viability of implementing indicators to the management of deep offshore marine fishery resources there is little or no control over both the resource location as well as the management decisions of the resource managers. As such, the choice of a case study approach

from among other approaches based on qualitative enquiry deploying interviews and questionnaires survey methods for this research.

A case study approach may be conducted by several modes or methods of generating data. As such it is not limited to the use of a particular form of data collection. It can be undertaken by using any of the traditional forms of data collection or a combination of one or more of them. This was also asserted by Yin, (1981) who highlighted the misconception by some scholars who regarded the case study approach as solely for ethnographies or participant observation. Yin, (1981) further characterised the case study as a research approach that may be equated to an experiment, a history or a simulation capable of being treated as an alternative research strategy.

Different scholars such as Hakim, (2000) and Robson, (2011) have variously classified the case study approach into a number of classes depending on their disciplines and convenience. However, the classification that appeared to be more acceptable and widely adopted by a number of social researchers including (Campbell, 1975; Platt, 1992; Yin, 1993; Yin, 1994; Thomas, 2011) is of three types, namely the descriptive, explanatory and exploratory case studies. Details of each in addition to its strengths and limitations will be discussed in succeeding subsections.

#### **4.2.1 Descriptive case study research**

This class of case study involves the description of a phenomenon through an accurate narrative of the basic information about an event. Its main objective is to decipher the phenomenal trend and most often provides comparisons of similarities or contrasts in given situations. They are also known for generating important insights and lessons that may lead to formulation or construction of hypotheses (Yin, 2004) and are often used when key variables are defined (Thomas, 2011).

#### **4.2.2 Explanatory case study research**

This is the common among the case study categories and may be in a form of speculative or context-specific narration (Thomas, 2011). It consists of meticulous interpretation of the facts of the case in question, considers substitute expression

of those facts and draws their conclusions based on single description that are in conformity with the facts (Yin, 1981). Key variables and relationships are usually defined in this type of research (Thomas, 2011).

#### **4.2.3 Exploratory case study research**

This type of research is undertaken when the researcher with little or no preliminary insight, needs to know why and how a phenomena happens. It is mostly preferred because the researcher may be able to at the end of the exercise obtain a multi-dimensional perspective of a given phenomenon (Yin, 1981; Yin, 2003) by incorporating multiple dimensions to the facts of the case being studied from a number of sources (Yin, 2004; Thomas, 2011). Another importance of the exploratory research is in validating or invalidating any held hypothesis from either a descriptive or an explanatory case assertions (Thomas, 2011). It has also been found to distinctively generate, test and elaborate on theory (George & Bennet, 2004; Ketokivi & Choi, 2014) contrary to some erroneously held misgivings (Gerring, 2004) as highlighted and deconstructed by Flyvbjerg, (2011).

#### **4.2.4 Advantages of case study research**

Some of the advantages of the case study research may include but not be limited to (1) its ability to define topics broadly and not narrowly by employing multiple methods from as varied a sample as possible thereby obtaining several dimensions to a phenomenal context. (2) The ability to cover contextual conditions alongside the phenomenon of the study; this it does by often highlighting multiple situations as it relates to a case simultaneously within its own context. (3) Its reliance on a multiple not singular sources of evidence-by the use of multiple methods usually involving a vast array of participants drawn across equally diverse backgrounds (Yin, 1993). This is a very strong advantage in that it may make the aggregation of both converging and diverging views observed over a given phenomenon in any context possible.

#### **4.2.5 Disadvantages of case study research**

Some of the disadvantages of the case study research may include but not be limited to (1) being often seen as possessing insufficient objectivity, rigour and

precision (quantification)-although this misunderstanding has already been successfully deconstructed by some scholars such as Flyvbjerg, (2006) and Flyvbjerg, (2011). (2) It is sometimes seen as only appropriate for the exploratory phase of a study compared to surveys, histories, experiments and other methods of enquiry-even this position was later challenged by some case study proponents such as Yin, (2003), Yin, (2004), Yin, (2009) and Flyvbjerg, (2011). (3) Its conclusions are also seen as likely to produce extended networks of implications that may make further scientific investigation or evaluation necessary (Yin, 2003). This may most especially apply to an exploratory investigation because as real-life events become clear, they often may generate some prepositions or hypothesis that may need to be further confirmed through another research. This may usually be a scientific one involving quantitative enquiry to establish validity or otherwise as opposed to a qualitative enquiry often with the use of interviews and questionnaires.

### **4.3 The use of questionnaire surveys**

While a single and generally acceptable definition of a questionnaire may not be available; a questionnaire may be defined as a set of questions that are designed to generate responses on issues, events and situations over a phenomenon of interest to researchers.

Oppenheim (1992), however, defined a questionnaire as a research tool that facilitates the collection of data by asking all or a sampled group of people to respond to the same questions which can either be in print or electronic form.

The objective of a questionnaire is to assess a certain benchmark and/or criteria for topics intended to be investigated that are derivable from the specification of the research design that is already drawn up and embraced from the commencement of the research (Oppenheim, 1992).

As such, questionnaires were adopted and used for the study so that varied responses from a range of stakeholders may be obtained for the same set of questions with a view to identifying differing views from across a broad range of carefully selected stakeholders.

### **4.3.1 Types of questionnaire survey**

There are basically two types of questionnaire survey, even though their modes of administration may be more. Questionnaires can either be made up of open or closed questions. They may be administered either face-to-face, by phone, by post or online (Robson, 2011; Thomas, 2011).

Open questions are when the respondent is given a chance to provide own answers without any form of restrictions while closed questions; as the name implies are when a certain number of alternative responses are provided to the respondent to choose from thereby limiting the variety of responses from the onset (Oppenheim, 1992).

### **4.3.2 Advantages of questionnaire survey**

Some of the advantages of questionnaire survey include but not limited to (1) Objectivity; because responses are gathered in a standardised way thereby enabling all potential respondents to answer the same questions. (2) It is relatively quicker and easier to obtain information using questionnaire than other methods most especially in a situation where sensitive issues are expected to be disclosed as they are most often filled or responded not in the presence of the researcher. (3) It has the potential of obtaining information from a large group of respondents and in different opinions as each and every respondent answers his/her questions independently thereby enabling a variety of opinions from same organisations. (4) They may also be relatively easy to design, create, code and interpret most especially if they are in closed format thereby making the analysis less cumbersome and less time-consuming (Oppenheim, 1992; Robson, 2011).

### **4.3.3 Disadvantages of questionnaire survey**

Some of the disadvantages of questionnaire survey include but are not limited to (1) their ability to have annoyingly low return rates. This is more so because respondents may be overwhelmed by their normal preoccupations or simply forget thereby making consistent reminder by the researcher very vital. (2) As an exercise aimed at eliciting responses usually after events has been conducted, respondents tend to forget some key issues involved which may affect the final outcome.

As such respondents' characteristics such as their knowledge, motivation and memory may affect the data being generated. (3) Questions in the questionnaire are usually standardised in their nature, as such it may often be difficult or almost impossible to detect where respondents misinterpret the issues at stake. This situation may make the whole essence of the exercise futile most especially where the issues central to the research are grossly misrepresented and misunderstood to the detriment of the research and the researcher (Oppenheim, 1992; Robson, 2011).

#### **4.4 The use of interview surveys**

There is no uniformly or generally acceptable definition of an interview available. It may be defined as a set of questions being verbally asked by a researcher or a reporter that is designed to generate responses on issues, events and situations over a phenomenon of interest to researchers.

Among several definitions, interviews have been defined as one of the appropriate research methods especially in a situation where a comprehensive understanding of an issue requires the expertise of highly knowledgeable people; most especially those found to be directly involved with it and in a situation where the opportunity presents itself. This is because of their ability to avail opportunities for in-depth investigation of an issue, follow-up questions, reactions and discussions (Babbie, 2007).

It has been postulated by Robson, (2011) that interviews alone may be employed primarily as the only method in a study. They are most often than not used in a combination with other methods such as questionnaires or observations. The use of interviews and questionnaires were adopted for this research survey for the purposes of generating the primary data.

##### **4.4.1 Types of interview surveys**

While the modes of their administration may be more, there are three types of interviews namely; structured, semi-structured and unstructured interviews (Robson, 2011; Thomas, 2011).

In structured interviews, questions are predetermined and follow an order that has been set before the administration thereby enabling both the interviewer and the interviewee to follow a predesigned pattern with little or no room for deviation (Robson, 2011).

In semi-structured interviews, questions are usually modified and suited to follow the flow of the topics in question. The interviewer presents the interviewee with the areas to be covered with a view to counselling the direction of the flow for the interview responses (Robson, 2011).

In unstructured interviews, questions can be based on the interviewer's area of interest but the responses or conversations are allowed to freely develop informally with a view to generating as much information from the interviewee as possible (Robson, 2011). This may be vital in seeking to obtain information on 'how' and 'why' issues from across a broad range of stakeholders. Because each and every one is expected to present responses differently leading to a variety of data on the same set of questions being generated.

#### **4.4.2 Advantages of interview surveys**

Some of the advantages of interview surveys include but are not limited to (1) interviews are considered as the most flexible way of finding out about things, events and issues of interest or concern-this is because questions may be designed to suit both the interviewer and interviewee and be guided in line with preferred focus especially in a semi-structured interview. (2) they serve as appropriate short cuts in answering the research questions-this is because when an interviewer asks questions directly, answers are instantly revealed and in real time thereby saving significant amount of time for both the researcher and the researched. (3) They offer opportunities for modification, probing motives and follow up responses in a way other methods cannot, especially when conducted in a face to face manner in addition to deciphering the gesticulating pattern of the respondent which may be very revealing as well (Robson, 2011).

### **4.4.3 Disadvantages of interview surveys**

Some of the disadvantages of interview surveys include but are not limited to (1) they can be time consuming-in a situation where a top executive is being interviewed; such sessions may be marred by unexpected and unplanned interruptions. Sometimes settling in to commence the interview may take significant amount of time despite prior arrangements due to the exigencies of duties or engagements of the interviewee. (2) There is the possibility of the interviewee not revealing some sensitive responses to issues being raised. This is more manifested in recorded interviews where participants may entertain the fear of being misquoted or caught on tape disclosing apparently confidential information. (3) There is the possibility of the respondent deviating away from the main issue of discussion-this may occur in a situation where a participant is being asked a follow up question and in trying to explain or put in context unknowingly deviates from the main issue. This most often happens in an open-ended or unstructured interview session (Robson, 2011; Thomas, 2011).

### **4.5 Construction of the survey questions/themes**

The research type or approach of this thesis may be viewed or termed as an exploratory case study that involved a qualitative enquiry based on primary and secondary data involving questionnaires and interviews surveys. This is based on the nature of the data which revealed 'how' viable and effective implementing the TWAP LME indicators would be in the JDZ and similar scenario (Yin, 1997; Yin, 2003).

As such, open-ended survey questions were designed to elicit practical responses on the nature of the fishery and the challenges faced therein as well as the viability and effectiveness of implementing the indicators from the stakeholders capable of answering the research questions (Oppenheim, 1992; Babbie, 2007).

The survey questions were developed and organised into five main themes, namely;

- The management structure
- Management policies adopted for JDZ fisheries
- Nature of fishing within the JDZ,

- Nature of IUU fishing around the JDZ and
- The level of awareness/ employment of indicators as shown in the questionnaire template depicted in Appendix Three.

This was undertaken to ensure the full participation of stakeholders and more so for the JDA by enabling the process to reveal their perceptions as well as the suitability of implementing the TWAP LME indicators in line with their management objectives, thereby making ranking and sorting interactively with stakeholders (Rice & Rochet, 2005; Potts, 2006).

#### **4.6 Identification and choice of the stakeholders**

The Nigeria-Sao Tome & Principe Joint Development Zone is located within the Gulf of Guinea and has a varied range of both direct and indirect stakeholders. These stakeholders have a variety of roles including resource management, maritime boundaries management, diplomacy, maritime security, fisheries research, pollution research, productivity research and civil society comprising of some consortium of independent experts. The stakeholders were carefully identified and chosen based on their roles and relevance as depicted in Table 4.0 along with their sampled populations.

Table 4.0: List of stakeholders

(Source: Author's own)

Name	Role	Contact Information	Proposed Number of Respondents
The JDA	JDZ Resources Management	Wuse 2, Abuja. Nigeria	12
NBC Nigeria	Boundary Management	Garki, Abuja. Nigeria	7
Boundary Commission of STP	Boundary Management	Marylbourne, Principe. STP	5
Fisheries Department, Nigeria	Fisheries Management	Garki, Abuja. Nigeria	8
Ministry of Fisheries, STP	Fisheries Management	The Secretariat, STP	8
Ministry of Foreign Affairs, Nigeria	<i>Diplomacy</i>	Garki, Abuja. Nigeria	2
Ministry of Foreign Affairs, STP	Diplomacy	The Secretariat, STP	2
Nigerian Navy	Maritime Security	Garki, Abuja. Nigeria	3
STP Navy	Maritime Security	The Secretariat, STP	3
Fish & Fishery Center, GCLME	Fishery Research	Luanda, Angola	3
Pollution & Ecosystem Health Center, GCLME	Marine Pollution Research	Owerri, Nigeria	2
Productivity Center, GCLME	Marine Productivity Research	Accra, Ghana	2
NOIMR, Nigeria	Marine & Oceanographic Research	Lagos, Nigeria	2
Prof. L. Awosika	Independent Expert	Abuja & UNCLCS	1
Dr. Maxwell Donkor	Independent Expert	UNIDO	1
<b>Total</b>			<b>61</b>

#### **4.7 Pilot testing the survey questions**

The survey questions were pilot tested across a broad range of participants comprising of academic members of the University staff and some few fellow PhD research students. This was in addition to a second tactful pilot conducted across some other colleagues and professionals in Nigeria. Responses were encouraging and early suggestions were incorporated prior to commencement of the field exercise.

#### **4.8 Summary**

Chapter four examined the theoretical components of the research design adopted. In Section 4.2 the classification of the case study approach was discussed while its components in Sections 4.2.1 to 4.2.5 appraised its typologies in addition to its merits and demerits.

Section 4.3 and its components in Sections 4.3.1 to 4.3.3 reviewed the use of questionnaires surveys, its types and also its advantages and disadvantages. Section 4.4 and its sub-units from Sections 4.4.1 to 4.4.3 explored the use of interview surveys, its types in addition to its merits and demerits. Section 4.5 scrutinised the procedures followed and themes adopted for the construction of the survey questions.

Section 4.6 delved into the identification and choice of the stakeholders in relation to their roles as they relate to the JDZ. Section 4.7 highlighted the pilot testing of the survey questions across a range of participants while section 4.8 summarises the chapter.

The next chapter will describe the details of the field survey conducted covering all the stakeholders and their locations. It will also explain the way the data was managed, the choice of analysis and the reason for obtaining feedback and comments from the main stakeholders.

## **Chapter Five: Presentation and interpretation of the Surveys data**

### **5.1 Introduction**

This chapter presents the survey steps and present the data obtained during the fieldwork. The survey was designed to cover four countries in Africa, namely; Nigeria, Sao Tome & Principe, Ghana and Angola. It was designed to obtain data from carefully identified stakeholders that are directly or indirectly related to the management of the shared marine fishery resources of the Nigeria-Sao Tome and Principe Joint Development Zone JDZ.

### **5.2 Presentation and interpretation of the surveys**

The following section presents the details of participants' recruitment, nature of the surveys administered, dates and response status/rates. Figure 5.0 depicts a map of Africa showing the countries where surveys were conducted and the map of the research area (Nigeria-Sao Tome & Principe joint Development Zone) highlighted by dotted lines in Figure 5.1.

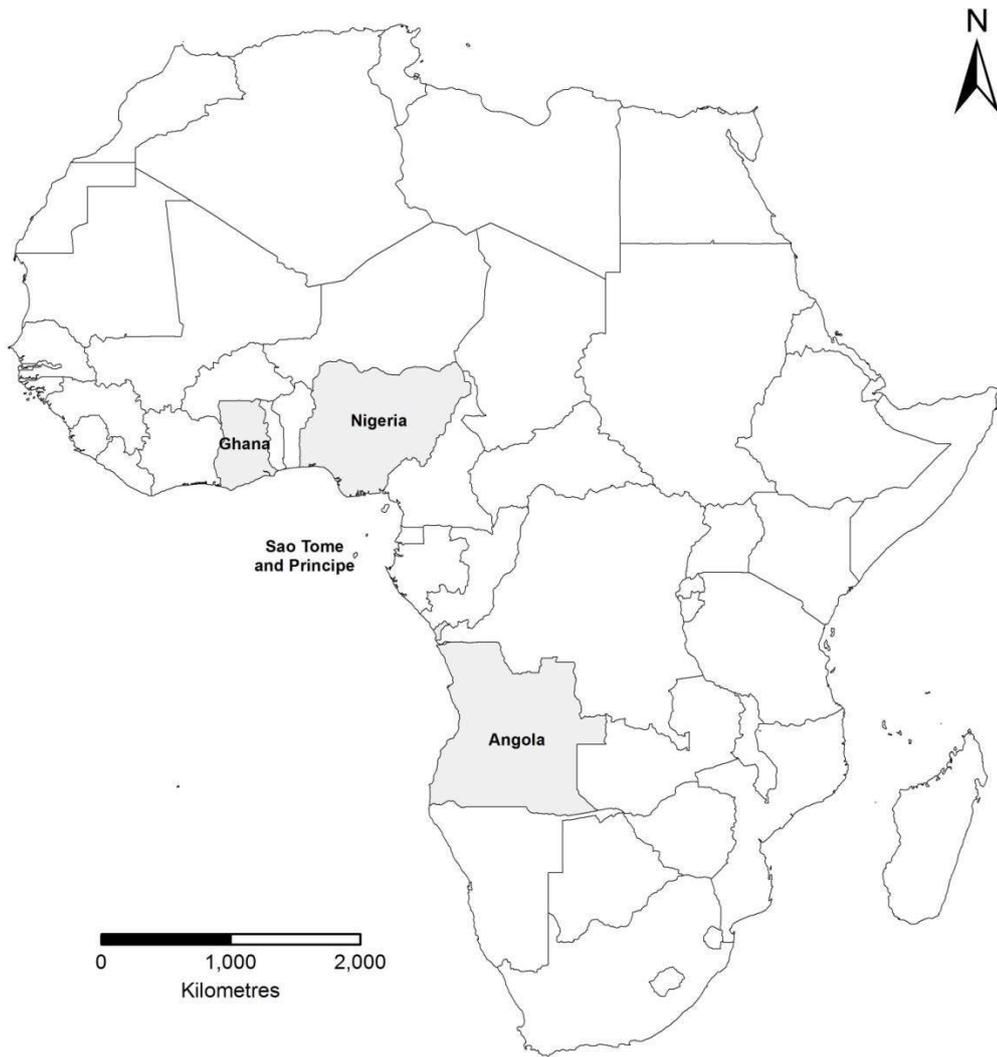


Figure 5.0: Map of Africa

(Source: Author's own)

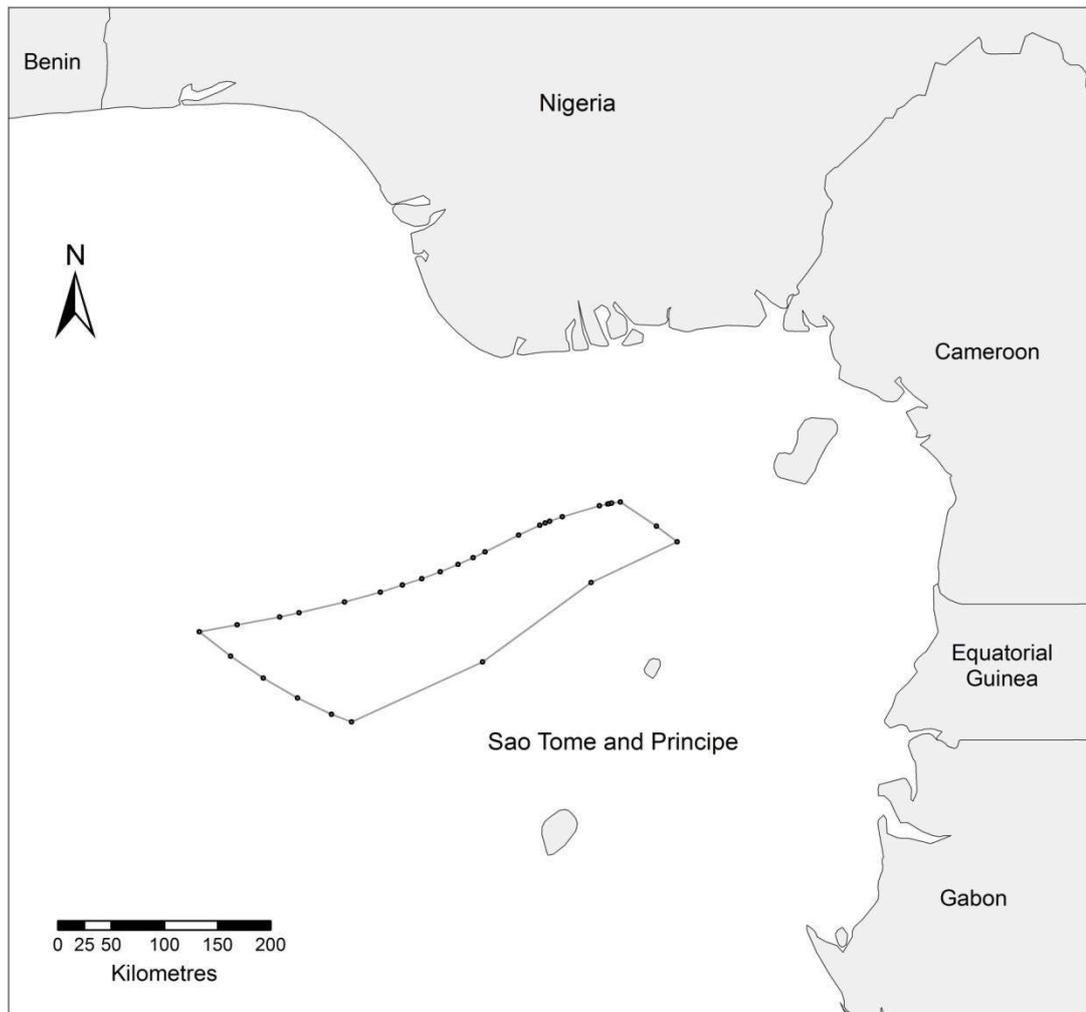


Figure 5.1: Map of the Nigeria-Sao Tome & Principe JDZ (Source: Author's own)

The survey was conducted over a three month period covering from 23<sup>rd</sup> July, 2013 to 24<sup>th</sup> October, 2013. It commenced with the Nigerian stakeholders followed by Sao Tome & Principe's stakeholders and Ghana. A visit to Angola was not possible due to difficulty in obtaining a visa and the subsequent discovery that all the three regional activity centres of the GCLME project have halted operations as a result of funding issues. It is however noteworthy that the two nations' ministries of foreign affairs turned down the invitations to participate, both of them insisting that their involvement with the JDZ activities were purely to bring the officials of the two countries together to commence negotiations. Of the two independent experts identified for the survey, only one responded to a questionnaire sent while an appointment for a telephone interview initially arranged for the second expert could not be held despite repeated efforts.

Sections 5.3 to 5.6.1 present a country stakeholder by country stakeholder summary of the survey administration and findings beginning with Nigeria:

### 5.3 Nigeria

Nigeria is a West African country whose EEZ lies among the sixteen African countries that are spread along the Gulf of Guinea. The country lies within the latitude 10°00'N 8°00'E and longitude 10°N 8°E and has an overlapping EEZ claim with Sao Tome & Principe over an area the two countries designated a Joint Development Zone JDZ. The stakeholders visited during the survey are situated within Nigeria as shown in the map containing their individual logos captioned in Figure 5.2:

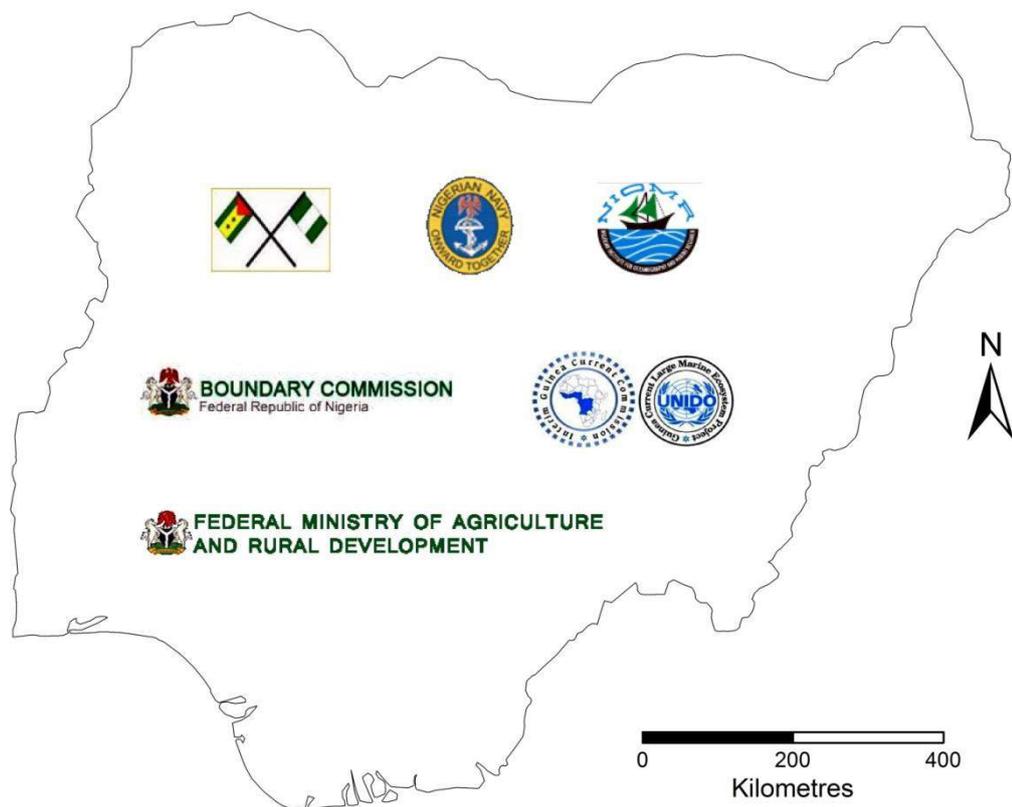


Figure 5.2: map of Nigeria depicting the logos of the survey stakeholders (Source: Author's own)

### 5.3.1 The JDA

Four interviews and eight questionnaires were designed for the JDA and invitations to participate were sent out. However, only two recorded interviews were conducted and seven questionnaires returned out of the eight sent out. A comprehensive survey report commissioned by the JDA in conjunction with FAO and the Norwegian Institute of Marine Research titled ‘Marine environmental survey of bottom fauna, selected physical and chemical compounds and fisheries survey in the Joint Development Zone between Nigeria and Sao Tome & Principe’ was obtained in the course of the field visit. Summary of participants, nature of surveys administered, dates and response rates are as detailed in Table 5.0:

Table 5.0: List of JDA stakeholders (Source: Author’s own)

Participants	Department	Survey type	Date sent	Date received	Response
Mr. Prazeres	C & I	Interview	30/07/13	21/08/13	Yes
Mr. Nascimento	NHR	Interview	30/07/13	02/09/13	Yes
Mr. Yabo	F & A	Questionnaire	30/07/13	21/10/13	Yes
Mr. Duba	C & I	Questionnaire	30/07/13	05/08/13	Yes
Mr. Uche-Okeke	NHR	Questionnaire	30/07/13	06/08/13	Yes
Mr. Iwu	NHR	Questionnaire	30/07/13	21/10/13	Yes
Mr. Adegbola	M & I	Questionnaire	30/07/13	07/08/13	Yes
Miss A Nzeche	C & I	Questionnaire	30/07/13	22/10/13	Yes
Mr. Gamboa	M & I	Questionnaire	30/07/13	-----	No
Mr. Nazare	NHR	Questionnaire	30/07/13	22/10/13	Yes

### 5.3.2 NBC Nigeria

One interview and six questionnaires were designed for the NBC Nigeria and invitations to participate were sent out; while one recorded interview was granted only five questionnaires were returned out of the six sent out. Details of the participants, nature of surveys administered, dates and response rates are as shown in Table 5.1:

Table5.1: List of NBC stakeholders

(Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Dr. Ahmad	D.G.O.	Interview	29/07/13	02/09/13	Yes
Mr. Agabi	R & P.A.	Questionnaire	29/07/13	20/08/13	Yes
Mr. Ibrahim	R & P.A.	Questionnaire	29/07/13	21/08/13	Yes
Mr. Abba	M & G.I.	Questionnaire	29/07/13	22/12/13	Yes
Mr. Sunsuwa	M & G.I.	Questionnaire	29/07/13	13/08/13	Yes
Mr. Shetima	I.S.B.	Questionnaire	29/07/13	--	No
Mr. Chindo	I.N.B.	Questionnaire	29/07/13	02/10/13	Yes

### 5.3.3 Fisheries Department of Nigeria

Two interviews and six questionnaires were designed for the Fisheries Department of Nigeria and invitations to participate were sent out. However, only one unrecorded interview was granted and four questionnaires returned out of the six given out. Table 5.2 illustrates the details of the participants, nature of surveys administered, dates and response rates:

Table 5.2: List of Fisheries department of Nigeria stakeholders (Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Mr. Anozie	M.C. & S.	Questionnaires	12/08/13	21/10/13	Yes
Mr. Babatunde	M.F.D.	Questionnaire	12/08/13	14/10/13	Yes
Mr. Abioye	M.C. & S.	Questionnaire	12/08/13	05/09/13	Yes
Mr. Ayeni	M.F.R.	Questionnaire	12/08/13	—	No
Mr. Lanre	M.I.F.	Questionnaire	12/08/13	05/09/13	Yes
Mrs. Odusote	P. S. O.	Interview	12/08/13	05/09/13	Yes
Mrs. Areola	Dir Off	Interview	12/08/13	---	No
Mr. Remi	M.I.F.	Questionnaire	12/08/13	---	No

### 5.3.4 Ministry of Foreign Affairs, Nigeria

One interview and one questionnaire were designed for the Ministry of Foreign Affairs of Nigeria and invitations to participate were sent out. However, any form of participation was declined and the only response obtained which was off the record was that the ministry only facilitated the negotiations which led to the bilateral signing of the treaty and nothing more. For that reason invitation to participate was turned down and the researcher was referred to the JDA, as such there are no survey details to be provided.

### 5.3.5 Nigerian Navy

One interview and two questionnaires were designed for the Nigerian Navy and invitations to participate were sent out. The navy granted a recorded interview by the Chief of Naval Operations of the Nigerian Navy and the two questionnaires given to senior officers were responded and returned. Details of the participants, the nature of surveys administered, dates and response status are as detailed in Table 5.3:

Table 5.3: List of Nigerian Navy participants (Source: Author's own)

Participant	Department	Survey type	Date sent	Date received	Response
Cdr. Okojie	Operations	Interview	30/07/13	06/08/13	Yes
N/Cpt. Iliya	Operations	Questionnaire	30/07/13	05/08/13	Yes
N/Cpt. Ayerite	Operations	Questionnaire	30/07/13	11/08/13	Yes

### 5.3.6 Pollution & Ecosystem Health RAC of the GCLME

One interview and one questionnaire were designed for the Pollution and Ecosystem health regional activity centre in Owerri, Nigeria. However, no interview could be arranged as the centre had similar fate with Angolan centre. However, contacts were established with the former members of staff who promised to participate and two questionnaires were sent. Despite repeated reminders they did not respond up till the time of compilation of the thesis. Current response rates, details of the participants contacted, dates and nature of surveys sent are as detailed in Table 5.4:

Table 5.4: List of P&E RAC participants (Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Mr. Chijoke	Research	Questionnaire	14/10/13	Expected	No
Mr. Akujobi	Research	Questionnaire	14/10/13	Expected	No

### 5.3.7 Nigeria Institute of Oceanography and Marine Research

One interview and one questionnaire were designed for the NIOMR and invitations to participate were sent out. A recorded interview request was turned down, while one unrecorded interview was granted and two members of staff who initially participated in the JDZ survey earlier responded and returned two completed questionnaires. Participants' details, response rates, nature of surveys administered and dates are as detailed in Table 5.5:

Table 5.5: List of NIOMR Participants (Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Mr. Williams	Fishery Res	Questionnaire	15/10/13	18/10/13	Yes
Mr. Ndubuisi	Marine Bio	Questionnaire	15/10/13	18/10/13	Yes
Dr. Ajao	Administration	Interview	15/10/13	17/10/13	Yes

## 5.4 Sao Tome & Principe

Sao Tome & Principe is an archipelagic small island state-comprising of two separate islands of Sao Tome and Principe-that is situated off the coast of Gulf of Guinea; it has its EEZ among the sixteen countries bordering the Guinea Current Large Marine Ecosystem GCLME. The country lies within the latitude 1°00'N and longitude 7°00'E and has an overlapping EEZ claim with Nigeria over an area mutually designated as a JDZ by the two countries. The logos stakeholders visited in Sao Tome & Principe are contained in the map as shown in Figure 5.3:

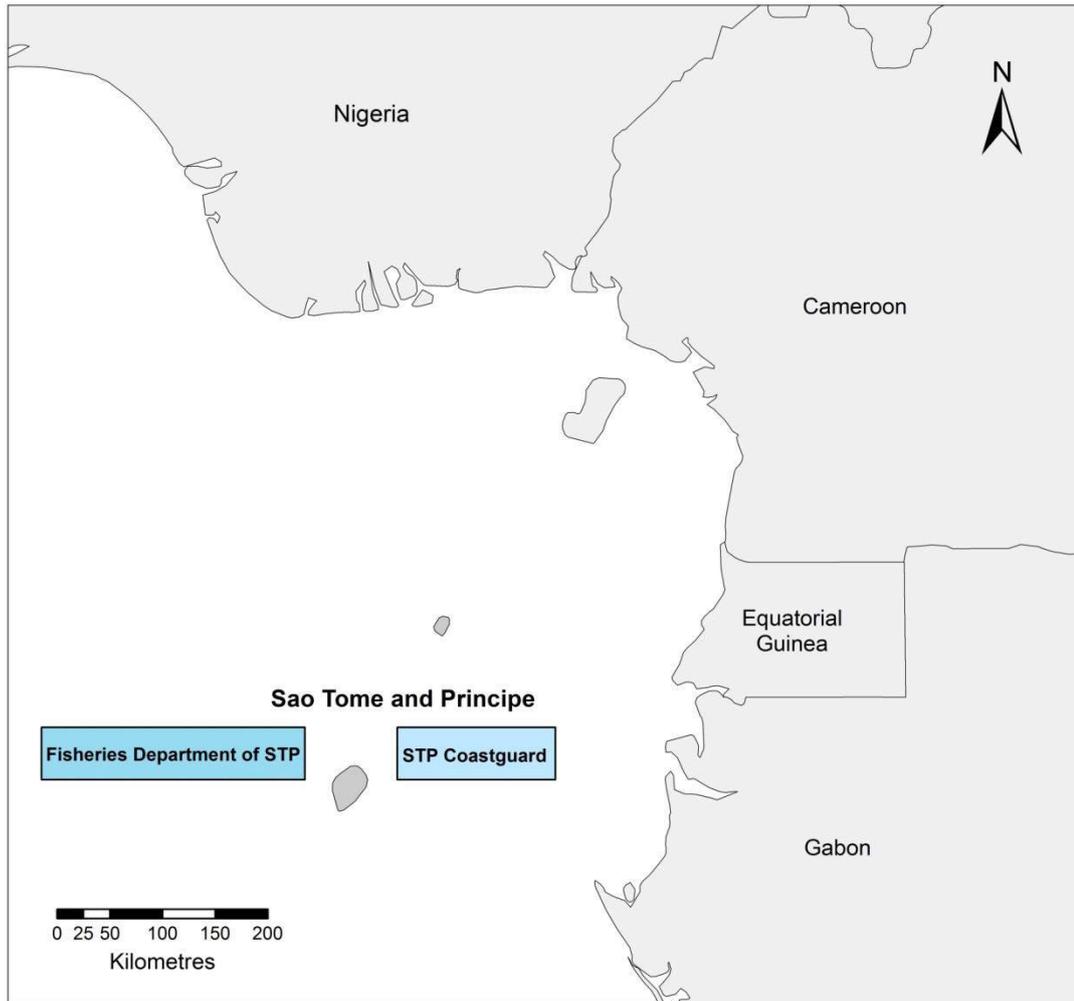


Figure 5.3: Map of the two archipelagic states of Sao Tome & Principe  
(Source: Author's own)

#### 5.4.1 Boundary Commission of Sao Tome & Principe

One interview and four questionnaires were designed for the Boundary Commission of Sao Tome & Principe. On reaching the country it was discovered that there is not in place a functional Boundary Commission but an ad-hoc committee that is usually inaugurated whenever the need arises. All efforts to speak to or contact present or past members of such an ad-hoc committee proved abortive despite repeated efforts to that effect. As such no details can be provided.

### 5.4.2 Fisheries Department of Sao Tome & Principe

Two interviews and six questionnaires were designed for the Fisheries Department of Sao Tome & Principe. However, no interview was obtained from them despite all entreaties and only one institutional questionnaire response was returned-on behalf of all respondents-from the eight given out. It is important to note that the eight questionnaires given were as a result of their request initially. This may not be unconnected to language barrier among other issues as they are a Portuguese colony and their official language is Portuguese. Details of the participants, nature of the survey administered, dates and response rates are as contained in Table 5.6:

Table 5.6: List of Fisheries Department of STP participants (Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Mr. Cravid	Fisheries	Interview	18/09/13	23/09/13	No
Mr. Deodato	Fisheries	Interview	18/09/13	23/09/13	No
Mr. Rosario	Fisheries	Questionnaire	18/09/13	23/09/13	Yes
Mr. Aurelio	Fisheries	Questionnaire	18/09/13	23/09/13	Yes
Mr. Diaz	Fisheries	Questionnaire	18/09/13	23/09/13	Yes
Mr. Santos	Fisheries	Questionnaire	18/09/13	23/09/13	Yes
Mr. D'Alba	Fisheries	Questionnaire	18/09/13	23/09/13	Yes
Miss Bandeira	Fisheries	Questionnaire	18/09/13	23/09/13	Yes

### 5.4.3 Ministry of Foreign Affairs, Sao Tome & Principe

One interview and one questionnaire were designed for the Ministry of Foreign Affairs of Sao Tome & Principe and invitations to participate were sent out. However, response was exactly the kind obtained from their Nigeria's counterpart with the revelation that the ministry was replaced recently as a representative of the STP in the JMC by the ministry of infrastructure and public works unilaterally by their president. As such no details can be provided.

#### 5.4.4 Sao Tome & Principe Coastguard

One interview and two questionnaires were designed for the Sao Tome & Principe's Navy. However the STP does not have a standing naval force as what they have is a small unit they call 'Coast Guard' and as such invitations to participate were sent out. An interview was flatly denied while questionnaires were received and a promise to participate was made but no completed questionnaire was returned up to the time the researcher left the country. A response is still expected via email as promised, but no response came up to the time of compilation of this thesis. It should be noted that the Coast Guard appeared to be more active only within the territorial waters of the country. Details of the participants contacted, the nature of the survey documents sent, dates and current response situation are as shown in Table 5.7:

Table 5.7: List of STP Coast Guard participants (Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Mr. Cruz	Operations	Questionnaire	17/09/13	Expected	No
Mr. Adriano	Operations	Questionnaire	17/09/13	Expected	No

#### 5.5 Ghana

Ghana is a West African country that is situated along the coast of Gulf of Guinea and also has its EEZ among the sixteen countries that are adjacent the GCLME. The productivity regional activity centre of the GCLME is situated in Legon, Ghana. It shares an approximately eight nautical mile EEZ with Nigeria at the very tail end of the two countries EEZ. Confirmatory measurements and negotiations are currently on going among officials for amicable settlement in the near future. The country lies within the latitude 1° 12' E and longitude 3° 15' W geographically. The stakeholders of the Productivity centre of the GCLME visited and their logo are located in Ghana as depicted on the map shown in Figure 5.4:



Figure 5.4: Map of Ghana and a logo of the GCLME inserted (Source: Author’s own)

### 5.5.1 Productivity centre of the GCLME

One interview and one questionnaire were designed for the Productivity regional centre in Ghana and invitations to participate were sent out. However, it was discovered that the regional activity centres were closed due to funding issues; but two former members of staff were identified, who agreed to participate and returned completed questionnaires. Details of the participants, the types of survey administered, dates and response rates are as shown in Table 5.8:

Table 5.8: List of the Productivity Centre participants (Source: Author’s own)

Participants	Department	Survey type	Date sent	Date received	Response
Miss Konadu-Twum	Fisheries	Questionnaire	07/10/13	10/10/13	Yes
Mr. Apetogbor	Fisheries	Questionnaire	07/10/13	10/10/13	Yes

## 5.6 Angola

Angola is located within the Southern African sub region and on the outer edge of the GCLME but the GCLME fish and fishery regional activity centre is located there. The country lies within the longitude 12°30'S and latitude 18°30'E. Although a visit to Angola was not possible during the survey due to the reason cited in Section 5.2, the F & F centre is located in Angola as shown in the map captioned Figure 5.5:

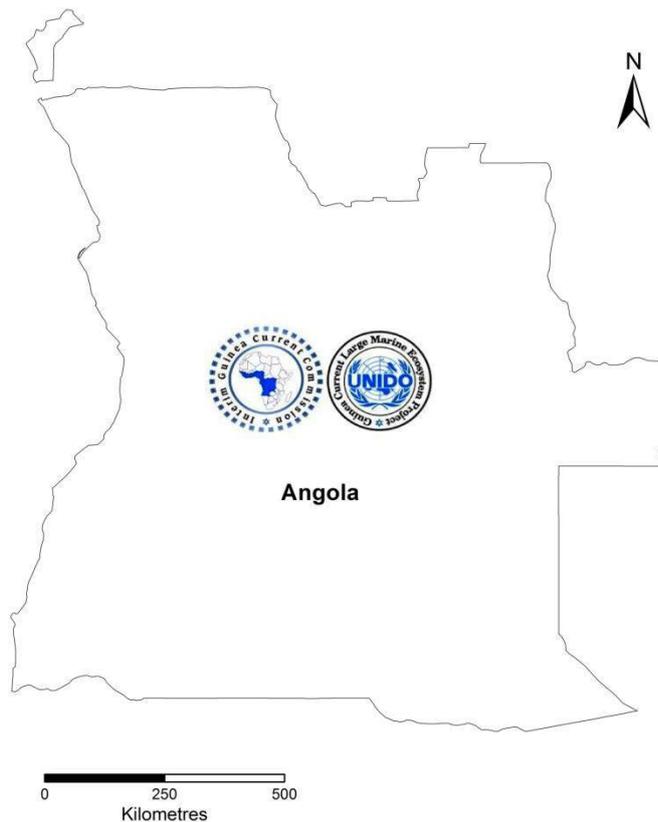


Figure 5.5: Map of Angola and logo of Fish and Fishery RAC (Source: Author's own)

### 5.6.1 Fish & Fishery centre of the GCLME

One interview and two questionnaires were designed for the Fish and Fisheries regional centre of the GCLME in Angola. A visit to Angola was not possible due to the reasons outlined earlier, but contacts of the former members of staff that worked on the project were obtained. Emails were sent to them comprising of all the survey documents inviting them to participate. However, there were no responses despite repeated reminders. Details of the two participants that were contacted and other information are as contained in Table 5.9:

Table 5.9: List of F&amp;F RAC participants

(Source: Author's own)

Participants	Department	Survey type	Date sent	Date received	Response
Miss Priscilla	Research	Questionnaire	22/10/13	Expected	No
Miss Santos	Research	Questionnaire	22/10/13	Expected	No

## 5.7 Independent experts

Two independent experts were identified for the survey and invitations were sent to them. Only one of them responded and returned the questionnaire while the other has not responded despite repeated efforts.

## 5.8 Survey Summary

Overall, a total of twenty two interviews and forty five questionnaires were planned for the survey. Out of these, a total of nine interviews were granted while twenty six questionnaires were returned from the forty five given out.

The Table 5.10 indicates role of each of the stakeholders, interviews planned and granted, questionnaires given and received, main contacts, and efforts put to encourage participation and the reasons given for not participating by the respondents.

Stakeholders	Role	Interviews planned	Interviews granted	Questionnaires given	Questionnaires responded	Main Contact	Efforts put to participate	Reason for not participating
The JDA	JDZ Resources management	4	2	8	7	Mr Prazeres	12 visits	Participated
NBC Nigeria	Boundary management	1	1	6	5	Dr M B Ahmad	14 visits	Participated
B C of STP	Boundary management	1	0	0	0	Nil	Nil	Nil
F D of Nigeria	Fisheries management	2	1	6	4	Mr Abioye	10 visits	Participated
F D of STP	Fisheries management	2	0	8	1	Mr G Rosario	6 visits	Partial participation
M F A Nigeria	Diplomacy	1	0	1	0	Permanent Secretary	2 visits	Bureaucracy/Irrelevance
M F A STP	Diplomacy	1	0	1	0	First Secretary	2 visits	Bureaucracy/Irrelevance
Nigerian Navy	Maritime security	1	1	2	2	Commodore Okojie	2 visits	Participated
STP Navy	Maritime security	1	0	2	0	Rui Vera Cruz	4 visits	None given Language Barrier
F & F RAC	Fishery research	1	0	2	0	Miss Nsiangango	4 emails	Visa Issues/ No Response
P & E RAC	Marine pol research	1	0	2	0	Mr A Chijoke	1 visit	Folded up
Productivity RAC	Productivity Research	1	1	1	2	Dr Yafe & Socrates	1 visit	Folded but participated
NIOMR Nigeria	Marine and Oceanographic Research	1	1	2	2	Mr Willaims & Mr Ndubuisi	5 visits	Participated
JDA Liaison Office STP	JDZ Resource management	2	2	2	2	Mr Azemiro & Mr Agbashi	4 visits	Participated
Prof Awosika	Independent expert	1	0	1	0	Prof Awosika	Nil	Nil
Halima Bwari	Independent expert	1	0	1	1	Mrs Bwari	Nil	Responded
<b>Total</b>		<b>22</b>	<b>9</b>	<b>45</b>	<b>26</b>		<b>65 visits</b>	

Table 5.10: Survey summary of stakeholders

(Source: Author's own)

### 5.9 General survey response summary

From Table 5.10, a total number of 45 questionnaires were planned representing 67% of the survey, while a total number of 22 interviews were planned representing 33% of the whole survey as depicted in Figures 5.6 and 5.7 represented in the pie chat and bar chart respectively:

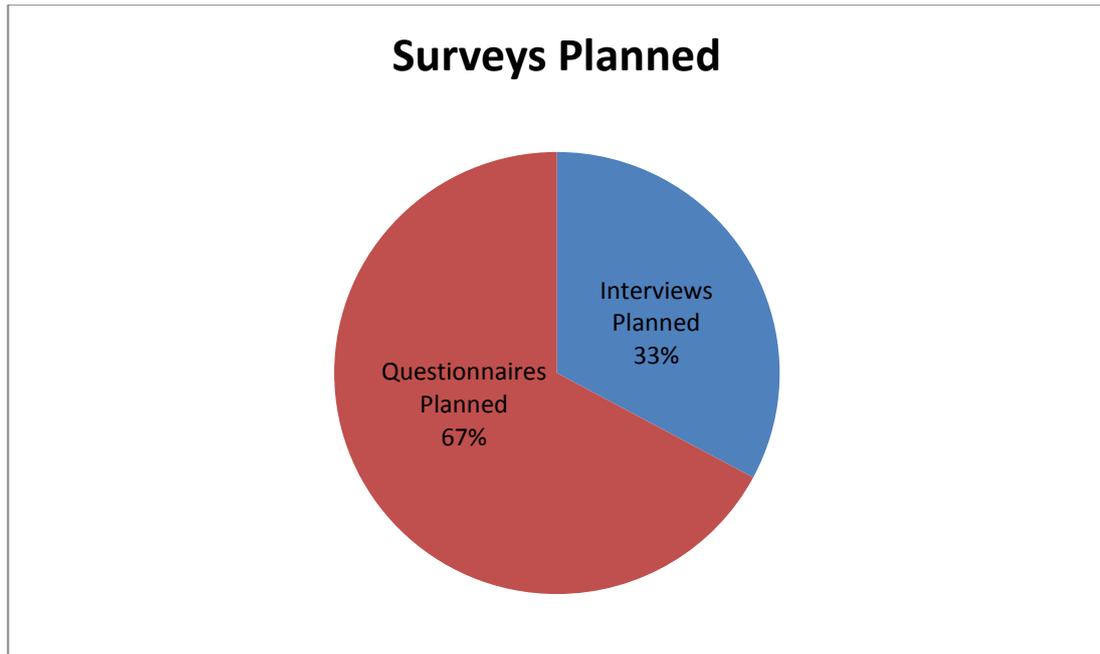


Figure 5.6-Percentage of planned surveys (Source: Author's own)

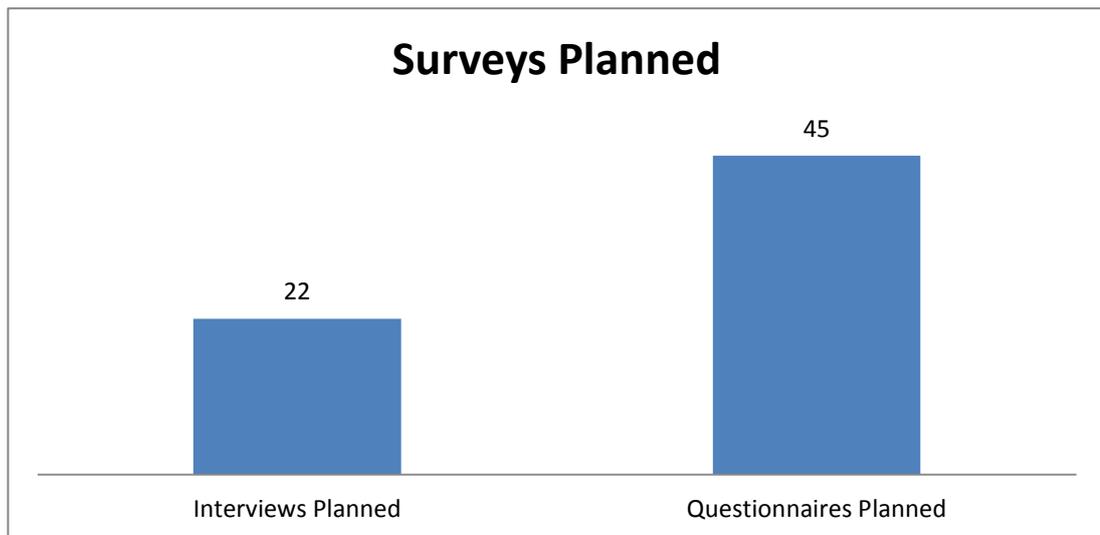


Figure 5.7-Number of planned surveys (Source: Author's own)

Furthermore, from the response status indicated in Table 5.10, out of the 45 questionnaires given, a total of 26 were returned representing 74% of the survey responses while out of the 22 interviews planned, a total of 9 interviews were granted representing 26% of the survey responses. This is visualised in Figures 5.8 and 5.9 as illustrated the pie chart and bar chart respectively:

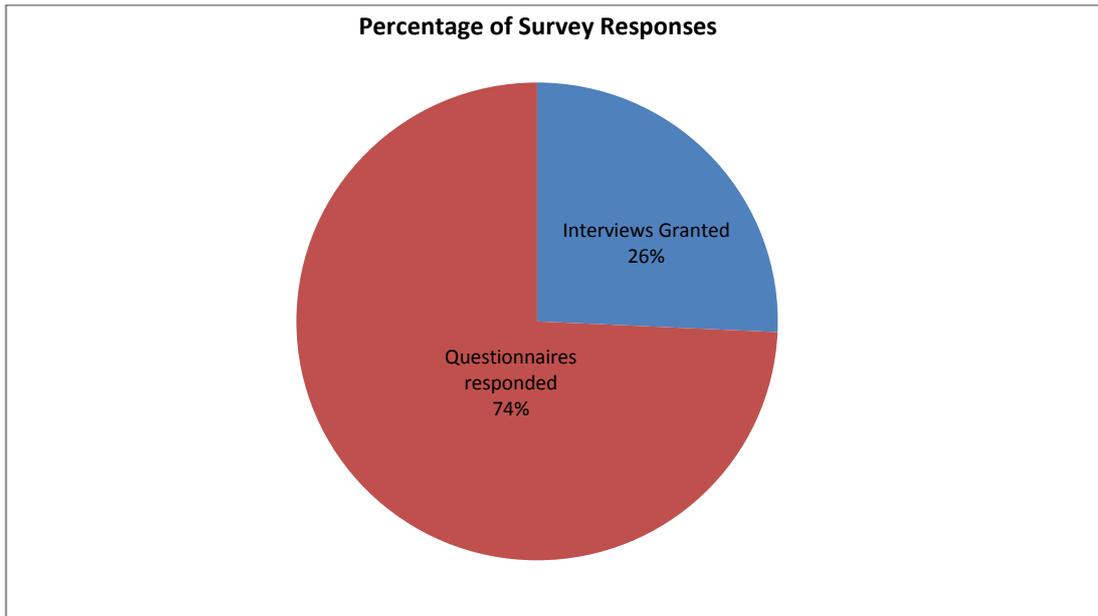


Figure 5.8-Percentage of survey response

(Source: Author's own)

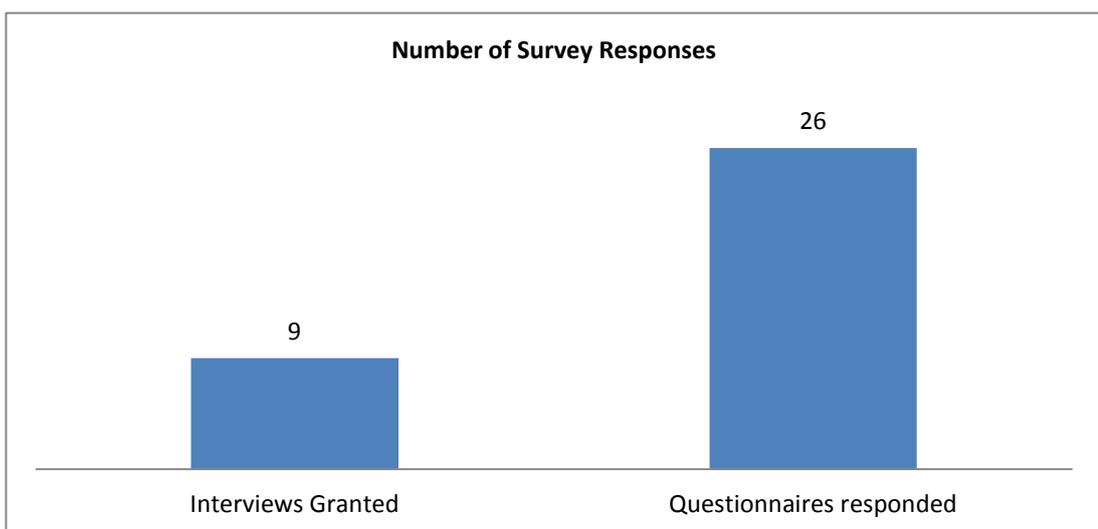


Figure 5.9-Number of survey response

(Source: Author's own)

## 5.10 Survey sectional response summary

The questionnaire was structured into five different sections as highlighted in Chapter Four Section 4.5, namely;

- The management structure,
- Management policies adopted for JDZ fishery,
- Nature of fishing within the JDZ,
- Nature of Illegal, Unregulated and Unreported (IUU) fishing around the JDZ and
- Level of awareness/employment of indicators.

While almost all the stakeholders responded to the first four sections with varied outcomes, almost all the respondents-including the main stakeholder-did not satisfactorily respond to the last section; depicting clear lack of awareness/employment of indicators as revealed in the responses.

This corroborated with the detailed responses in the questionnaire and the feedback and comments document regarding the status of fishery management of the JDZ which would be discussed further in the analyses. Table 5.11 illustrates the section by section stakeholder responses:

Table 5.11: Summary of stakeholder by stakeholder responses to the survey themes  
(Source: Author's own)

Stakeholders	Management structure	Management policies adopted for JDZ fishery	Nature of fishing within the JDZ	Nature of IUU fishing around the JDZ	Level of awareness/employment of indicators
The JDA	X	X	X	X	X
NBC Nigeria	X		X	X	
B C of STP					
F D of Nigeria	X	X	X	X	
F D of STP	X	X		X	
M F A Nigeria					
M F A STP					
Nigerian Navy	X	X	X	X	X
STP Navy					
F & F RAC					
P & E RAC					
Productivity RAC	X	X	X	X	X
NIOMR Nigeria	X	X	X	X	
JDA Liaison Office STP	X	X	X		
Prof Awosika					
Halima Bwari	X		X		X

### **5.11 Data Management and choice of analysis**

The data was managed using Microsoft Access 2007 a relational database which allowed the data to be stored, organised and manipulated. The primary data was generated from the questionnaire constructed around fact-finding questions and the level of awareness and employment of the TWAP LME indicators. This approach that has so far proven useful in ecosystem based assessments in the US, elsewhere and some parts of Africa (Breton, 2006; Sherman et al, 2009; IOC-UNESCO, 2011).

It was transcribed into 'tables' per each of the stakeholders based on each of the themes and for each of the questions. Queries were run in order to establish relationships between each stakeholder's response with others with a view to establishing patterns which enabled categorisations of the similarities and dissimilarities between and among all the respondents.

'Queries' were then made to decipher relationships from across the range of respondents, out of which clear 'forms' emerged. Each query was then compared with responses from across all the tables for each stakeholder with a view to obtaining individual reports.

This enabled 'reports' to be generated based on the relationships and positions of each of the stakeholders. Lastly the data was analysed after coding manually to generate similar and like patterns using 'content analyses' and reported in Chapters Six and Seven.

### **5.12 Obtaining feedback/comments from the main stakeholder**

#### **(JDA)**

After the analyses, some key issues emerged as reported in Section 6.8.1 which observed the absence of a substantive fishery regime for the JDZ fisheries and the seeming lack of integration and synergy between and among critical stakeholders. This necessitated the need to obtain feedback and comments from the main stakeholders (the JDA) with a view to integrating them into the research in line with the requirements of the development of indicators (Rice & Rochet, 2005) which strongly promotes interacting closely with potential users.

Feedback and comments were sought from the JDA which comprised of a document containing the details of the TWAP-LME indicators, scoring criteria and information on the selection pattern as shown in Section 7.7. This was in addition to highlighting a step by step approach towards establishing an indicator-based marine fishery assessment. The feedback and comments are integrated in Section 8.3.

### **5.13 Summary**

Chapter Five explained the conduct of the field survey by detailing the stakeholders and their recruitment in addition to the way the data was managed and analysed.

Sections 5.3 to 5.3.7 highlighted the Nigerian stakeholders, while Sections 5.4 to 5.4.4 featured Sao Tome & Principe stakeholders and Sections 5.5 to 5.5.1 covered Ghana stakeholders. The Angolan stakeholders were covered in Sections 5.6 to 5.6.1. The independent stakeholders were featured in Section 5.7. The surveys summary, response summary, sectional response summary, data management and choice of analysis and the necessity of obtaining feedback and comments from the JDA were covered in Sections 5.7, 5.8, 5.9, 5.10, 5.11 and 5.12 respectively.

Chapter Six will present the questionnaires and interviews analyses.

## **Chapter Six: Questionnaire and Interview Surveys Analysis**

### **6.1 Introduction**

This chapter presents the first stage of the analysis undertaken with respect to the five main themes of the survey questions across all the respondents. The survey was designed to obtain data capable of revealing how the resources of the JDZ are being managed by the JDA under five main themes. These are (1) the management structure of the JDA (2) management policies adopted for the JDZ fisheries (3) nature of fishing within the JDZ (4) nature of IUU fishing around the JDZ and (5) the level of awareness/ employment of indicators for the JDZ fisheries assessment from across all the spectrum of identified stakeholders.

### **6.2 Objectives of the survey**

The main objective of the survey was to elicit practical responses on the viability and effectiveness of implementing the indicators and other governance issues from experts and the practitioners employed to manage the JDZ resources as well as other carefully identified stakeholders. It was also to find out how the JDZ fishery resources are managed, the policies formulated and adopted for their management as well as the relationship between the identified stakeholders and the JDA. This was to reveal the level of synergy, cooperation and collaboration between and among relevant stakeholders with a view to identifying where JDZ fisheries management is optimal or sub-optimal.

Survey questions were designed to obtain data capable of eliciting practical responses on the nature of the fishery and the challenges faced therein as well as the viability and effectiveness of implementing the indicators from the stakeholders so as to reveal answers to the research questions (Oppenheim, 1992; Barbie, 2007).

This was to ensure the full participation of stakeholders by enabling the process to reveal their perceptions as well as the suitability or otherwise of implementing the TWAP LME indicators in line with their management objectives. This is the approach suggested and promoted by some scholars on the ways of implementing indicator-based fisheries assessments (Rice & Rochet, 2005; Potts, 2006). Open ended questions were conceived and constructed around these issues and are

expected to provide insights into the real life situation experiences as well as the feasibility of implementing the indicators.

Data from the questionnaires and interviews were managed by Microsoft Access relational database where relationships and queries were established, reports produced and inferences drawn from them upon which the analyses were based. The contents of the data were analysed using 'content analysis'; while the survey reports was analysed through document analysis as highlighted in Section 5.11.

### **6.3 The management structure**

This section of the survey was designed to collect information regarding stakeholders' organisational management structure in relation to the JDZ marine fisheries management. The following sub-sections contained the analysed results from the surveys in relation to role of stakeholders, their fitness into the JDZ fisheries management, participants' involvement with their organisations, stakeholders' monitoring of the JDZ fisheries resources and direct involvement with JDZ fisheries management by stakeholders' departments.

#### **6.3.1 Role of stakeholders**

While the status of the JDA as the legally guaranteed entity to manage the resources of the JDZ has not been questioned by all stakeholders, they equally revealed variety of participation levels in terms of how the JDZ resources are managed from the data. For example, the Fisheries Department of Nigeria is responsible for the formulation and implementation of fisheries policies in the whole of Nigerian marine waters including its EEZ which includes part of the JDZ while its STP's counterpart are only remotely aware of the JDZ activities. This is because it has been established from the survey that the STP fisheries department do not maintain sufficient collaboration with the JDA to warrant adequate sensitization as well as hitherto lukewarm attitude of the JDA management to exploration and exploitation of its marine living resources.

Similarly, the Nigerian Navy's role is to assist in the coordination of enforcement of fisheries laws, conventions and treaties that are entered into by Nigeria. It does this as a constitutionally mandated organisation responsible for the seaward defences

of Nigeria. Another stakeholder with a varied role is the Nigerian National Boundary Commission (NBC); whose role is the delimitation of the country's maritime boundaries, provision of policy guidelines and the determination of overlapping maritime boundary claims where such occurs among others. Data from the boundary commission of STP (found to be operating on ad-hoc basis) on the other hand could not be obtained despite concerted efforts to administer the survey as revealed in the preceding chapter.

The role of the NIOMR is to carry out research into the fishery resources within Nigerian estuary and marine waters up to the border of its EEZ in order to ascertain the biology, abundance and distribution of all aquatic resources including but not limited to fisheries. This is similar to the roles played by the other national stakeholders whose jurisdiction ends within the EEZ of their respective national territories both in Nigeria and Sao Tome and Principe.

The productivity centre of the GCLME coordinates all fisheries activities among the 16 countries of the region in terms of capacity building, research and assisting countries conduct surveys to recover depleted fisheries while the project was on-going. Perhaps, it is because of the termination of the GEF-GCLME project that the JDA collaborated with the Norwegian Institute of Marine Research in conducting its preliminary survey rather than any of the three regional activity centres of the GCLME. The independent stakeholder does not have any particular role as revealed from the data thereby signifying clear absence of stakeholder engagement in the management of the JDZ fishery resources.

Table 6.0 illustrates summary of the variety of stakeholders' roles in the management structure of the JDZ fisheries resources as revealed from the analysed data:

Table 6.0: Summary of stakeholders' roles in JDZ fisheries management  
(Source: Author's own)

Stakeholders	Roles in JDZ fisheries management
The JDA	Constitutionally and legally recognised body set up to manage the JDZ resources.
NBC Nigeria	Determination and delimitation of Nigeria's maritime boundaries.
Boundary Commission of STP	Unclear role (Data was not obtained)
Fisheries Department of Nigeria	Formulation and implementation of fisheries policies for the Nigerian waters up to EEZ.
Fisheries Department of the STP	Only remotely aware of the JDZ fisheries resources due to lack of collaboration.
Ministry of Foreign Affairs Nigeria	Unclear role (Declined participation in survey)
Ministry of Foreign Affairs of STP	Unclear role (Declined participation in survey)
Nigerian Navy	Responsible for seaward defences and coordination and enforcement of fisheries laws.
STP Navy (Coastguard)	Unclear role-Did not respond to the survey despite invitation and repeated reminders.
Fish & Fishery Centre of the GCLME	Unclear role-Centre folded up due to issues of funding from partners (GEF).
Pollution & Ecosystem Health Centre, GCLME	Unclear role-Did not respond to the survey despite invitation and repeated reminders.
Productivity Centre of the GCLME	Coordination of the 16 countries fisheries activities in terms of capacity building when it was operating.
NIOMR Nigeria	Undertaking research to ascertain the biology, abundance and distribution of all aquatic resources within the Nigerian marine waters.
Independent Stakeholder	No particular role

### 6.3.2 Stakeholders fitness in the JDZ fisheries management

Results from the survey indicated that the JDA is the only body recognised and assigned by law to manage the entire resources of the JDZ including both the living and non-living resources and as such fits adequately to manage or oversee the fishery resources of the JDZ. While the liaison office at STP represents the JDA in the country and operates as a link between the JDA and the STP public.

The NBC fits as the custodian of the Nigerian maritime boundaries and a member of the JMC to which the JDA is answerable. It does this by contributing to the formulation of policies, guidance and direction for the day to day running of the JDZ. This is in addition to delimiting boundary lines for the maintenance of sovereignty of the Nigerian territorial limits. This depicts an indirect oversight as against a more direct collaboration between and among critical stakeholders in the sustainable management of the JDZ resources. This is because the presence of a critical stakeholder such as the NBC might foreclose potential sources of conflict most especially when issues of transboundary concerns arise in the course of the collaboration such as in settling migratory fishery resources concerns.

As a member of the Fisheries Committee of the West Central Gulf of Guinea (FCWC), the Fisheries Department of Nigeria coordinates the management, conservation and utilization of the marine living resources within the EEZ waters of Nigeria. This includes a part of the JDZ but does not extend to the other part of the JDZ on the STP side. This is unarguably the reason why currently the JDZ is thinking of collaborating with the fishery departments of the two nations with a view to obtaining permission for encroachment into their EEZs so as to simplify licencing issues with potential investors as revealed by the ED-NHR of the JDA during the course of the interview survey.

The Fisheries Department of STP on the contrary appeared to be unaware of what transpires completely with the JDZ fisheries management largely due to inconsistencies in policies and continuous movement of responsibilities between and among various units of their government. A typical scenario as revealed by the survey was when the responsibility of the JDZ representation moved across four

different government agencies over a period of one year. Initially when the JDZ was established, the foreign affairs ministry was the sole representative on behalf of the STP government. This responsibility was later moved to the ministry of natural resources, then to the Prime Minister's office followed by the Agriculture ministry and lastly moved back again to the natural resources ministry.

The Nigerian Navy qualifies as the body responsible for safeguarding the Nigerian territorial seas and enforcement of its regulations. It does this by collaborating with other stakeholders to ensure the creation of the conditions appropriate for legitimate fishing to thrive, because the entire stretch of the JDZ can be said to be prone to IUU fishing due to lack of adequate legal framework to operationalise the need for required constant patrols. This was reiterated during the interview with the naval head of operations when he highlighted the consistent problem of inability to prosecute apprehended offenders that have always been caught and handed over to Nigeria's law enforcement officers for prosecution.

The productivity centre of the GCLME qualifies as one of the Regional Activity Centres (RAC) for the Gulf of Guinea LME project whose primary function was to mediate among member countries by creating platforms upon which members collaborate and share information on the status of the marine living resources productivity of the GCLME region. However, as observed earlier in Section 5.2 all the RACs have folded up and the project put on hold due to lack of funding commitments from the GEF and the participating countries as revealed by the former regional coordinator of the centre during an informal chat.

Analysis of the responses from the NIOMR revealed that while the institute is well positioned to carry out marine resource surveys as the only recognised marine research institute in Nigeria, it is not sure if it fits into the JDZ management structure apart from the mandate to undertake research within the Nigerian waters up to its EEZ. This is because the JDZ cuts across two different countries EEZs and any attempt to cover the two in the name of covering the JDZ might amount to an encroachment into a sovereign country's EEZ. This is unarguably another reason the JDA management is seriously considering making a request for permission from the

two nations for an encroachment into their individual EEZs with a view to simplifying licencing due to the transboundary nature of the resources and as well as the need to ease potential conflict that may arise due to targeted species imminent migration.

The independent expert does not currently fit into the JDZ fishery management because of the absence of stakeholders' involvement. This is evident from other stakeholders' suitability. As a result, sufficient sensitization is required in order to ensure adequate stakeholders' participation as suggested by ecosystem based management practices and approaches.

Table 6.1 illustrates summary of the variety of stakeholders' fitness into the JDZ fisheries management as revealed from the analysed data:

Table 6.1: Summary of stakeholders' fitness in the JDZ fisheries management  
(Source: Author's own)

Stakeholders	Stakeholders fitness in the JDZ fisheries management
The JDA	As the only body set up to manage JDZ resources
NBC Nigeria	Custodian of Nigeria's maritime boundaries
Boundary Commission of STP	Unclear role (Data was not obtained)
Fisheries Department of Nigeria	Coordinates the management, conservation and utilization of marine living resources within Nigeria's EEZ and as a member of the FCWC.
Fisheries Department of the STP	Unsure where it fits due to lack of collaboration
Ministry of Foreign Affairs Nigeria	Not specified (Declined participation in survey)
Ministry of Foreign Affairs of STP	Not specified (Declined participation in survey)
Nigerian Navy	Safeguarding Nigeria's territorial waters.
STP Navy (Coastguard)	Unclear-did not respond to survey
Fish & Fishery Centre of the GCLME	Unclear role-Centre folded up
Pollution & Ecosystem Health Centre, GCLME	Unclear role-Did not respond
Productivity Centre of the GCLME	Mediation among GCLME member countries
NIOMR Nigeria	Mainly research into Nigeria's EEZ but unsure of its fitness in JDZ fisheries management
Independent Stakeholder	No particular role currently but strongly suggest stakeholder engagement

### 6.3.3 Participants involvement with their organisations

Analysis of the data revealed varied degrees of involvement with participants' organisations and also the issue of frequent movement of personnel both within departmental units and among hierarchies. These trends have the tendency of affecting policy implementation because policies are not likely to be consolidated when frequency of the staff movement is high or consistent.

Participants from the JDA have been involved individually from its inception to 2013 occupying different positions ranging from field officers to Executive Directors. A point worthy of note in the JDA is the way the Executive Directors are being continuously reshuffled across the main four departments. An example is the current ED (NHR); who was appointed ED (C&I) in 2010 and recently transferred to NHR in early 2013. This sort of movement affects policy implementation because a new Director needs to settle in their post before being abreast with the department's challenges and more so when he or she is posted from a different background than the one needed for his current post as in the case of the ED (NHR).

At the NBC, involvement of participants with the Commission spans across a range of 15 to 30 years indicating a rather more sustained engagement with the organisation. However, a few cases of rapid transfer among the directorate and mid-management staff cadre were also observed. This may however not significantly impact on the JDZ fisheries management as the NBC has an indirect involvement in the JDZ fisheries management.

In the Fisheries Department of Nigeria, data revealed that the executive respondents (Directorate staff) have been involved in their organisation since 1983 where they rose to the present positions signifying a strong consistency capable of consolidating policy formulation and implementation. However, other categories of participants have been found to be individually engaged with the organisation over a period of time that range from 1980s to 2004. In the STP fisheries department, involvement of the participants range between 15 to 30 years and appeared to be well embedded in the department despite their claim of insufficient collaboration or partnership with the JDA over the activities within the JDZ.

In the Nigerian Navy, the Director of Operations who granted the interview on behalf of the Chief of Naval Staff have been found to be involved with the Navy for over 30 years where he rose to become a Commodore in the Navy, whereas the other two senior members of staff that participated in the survey have been found to be involved for over 20 years and are both on the rank of Navy Captain.

Involvement in the Productivity centre of the GCLME was found to be within the range of two to five years reflecting the period of the project although it has since stopped operations as attested to in Section 5.2 in Chapter Five and Section 6.3.2 of this Chapter.

Similarly, the NIOMR participants were found to have been involved with their organisation over a period of time that ranges from nine to thirty years. The Director of the institute who granted the interview for the survey was proceeding on his terminal leave a few days after the survey. The principal research officer spent over twenty years in their post while the field officer who was recently elevated to the rank of senior research officer has been involved with the institute for the past ten years based on the data obtained. The independent stakeholder on the other hand has been on and off various government posts over a period of four decades and has recently just concluded a consultancy service hired by the Nigeria's Federal Ministry of Environment for the GCLME project when it was on going.

Table 6.2 illustrates a summary of the variety of participants' involvement with their various organisations as revealed from the analysed data:

Table 6.2: Summary of the duration of stakeholders' involvement with their organisations  
(Source: Author's own)

Stakeholders	Duration of participants' involvement with Stakeholders
The JDA	4 to 12 years
NBC Nigeria	15 to 30 years
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	25 to over 30 years
Fisheries Department of the STP	15 to 30 years
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	20 to 30 years
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	2 to 5 years
NIOMR Nigeria	9 to 30 years
Independent Stakeholder	Over forty years

#### 6.3.4 Stakeholders monitoring of JDZ fisheries resources

In the JDA generally, there is a dedicated department specifically for the overall monitoring of the entire JDZ resources; the Monitoring and Inspection (M&I) department. The fisheries resources are managed by the NHR department. Although the JDA as a body is still in the process of setting up its fisheries regime, it is envisaged however that the fisheries resources would be managed collectively by the NHR and M&I departments when the fisheries management operations becomes fully operational. This is expected to commence when licences or quotas are issued to prospective investors for the exploitation of the fisheries resources in the near future as revealed from the survey. As such, monitoring for the fisheries is yet to commence fully but consultations have been on going as far back as 2005 with ICCAT and FAO towards that direction.

It is noteworthy however that the JDA has not been paying requisite attention to its fisheries resources until now as all their efforts have been geared towards exploration and exploitation of the hydrocarbons resources found in the JDZ. This was repeatedly confirmed by the Chairman of the board and the ED NHR during the interviews conducted for the survey. This was captured more succinctly by the Chairman when he mentioned 'But mainly, since the beginning parties have honestly been concerned mainly with the hydrocarbons may be because hydrocarbons give you the money immediately....ok. But we have been making some big efforts as far as developing the fishery is concerned. First of all when we started....ok....eh....we had some experience on hydrocarbons....that....ah...which was reflected in 2003 when our first task was to conduct the first licensing round of the oil blocks....but at the same we started preparing for the non-hydrocarbons. So.....it was not immediately because everyone.....and I remember even at that time.....even the director of non-hydrocarbons was more focused on following up what was happening in the hydrocarbons than fishery you know. But later the JDA resolved to focus more on the non-hydrocarbons as well mainly fishery with a plan on how to make things happen'.

The NBC does not have a direct monitoring role for the JDZ, but does monitor sea level rise along the Nigeria's maritime boundaries with a view to determining water level position for delimitating maritime boundaries.

In the Fisheries Department of Nigeria; two departments are responsible for the monitoring of activities within the Nigerian maritime waters and they are the marine industrial fisheries department and the monitoring, control and surveillance department. They monitor by collecting, collating, processing and disseminating industrial fisheries data at fish landing jetties along the country's coastline. The survey further revealed they mostly rely on the little efforts of the Nigerian Navy for the monitoring exercise due to lack of sea going vessels and other equipment.

In the STP Fisheries Department however, it has been discovered that the department does not monitor or have any monitoring arrangement in place for the JDZ fishery. Nonetheless, all participants are of the view that JDZ monitoring should involve permanent partnership between them and the JDA. This further echoed the previous discovery as reported in Section 6.3.3 that the STP Fisheries Department does not have the required level of involvement with the JDZ activities despite being an Archipelago State whose economy is almost totally dependent on coastal and marine fishery.

The survey revealed that the Nigerian Navy does not have a regular and dedicated patrol system for the JDZ and even the entirety of the country's EEZ. It has only recently commenced discussion with the fisheries department of Nigeria so as to have an MOU that will pave the way for the provision of dedicated patrol vessels for the entire EEZ. It further revealed that the JDZ is located within the eastern naval command's area of operation and that from the little efforts of their patrol under general duties, have been responsible for the apprehension of several fisheries regulations offenders who are constantly been handed over to the relevant agencies for prosecution.

Participants from the Productivity Centre of the GCLME revealed that the centre is not directly involved in monitoring any unit of the GCLME such as the JDZ as monitoring can only be undertaken by the resource managers because their role

was solely in assisting with scientific information on productivity of resources to interested parties during their operational period.

Similarly, the NIOMR monitors the Nigerian waters through its annual surveys which it undertakes in conjunction with EAF-NANSEN project and as such is not directly involved in the monitoring of the JDZ fisheries.

The independent participant was of the view that a collective monitoring involving all stakeholders should be initiated and pursued vigorously with a view to institutionalising such activity so that all partners will have sufficient information that may be helpful in curbing illegal fishing activities most especially since the entire Gulf of Guinea is known to be prone to IUU fishing activities.

Stakeholders' level and status of JDZ fisheries monitoring are as depicted in Table 6.3:

Table 6.3: Level of stakeholders' JDZ monitoring and status (Source: Author's own)

Stakeholders	Status and level of monitoring for JDZ fisheries
The JDA	Partial monitoring currently -direct responsibility through the M&I and the NHR departments
NBC Nigeria	Indirect monitoring-monitors sea level rise with a view to delimitating maritime boundaries
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Indirect monitoring through collection, collation and dissemination of data limited to Nigerian waters
Fisheries Department of the STP	No monitoring arrangement in place yet but believe permanent partnership should be established
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Direct monitoring through policing Nigerian waters but does not have dedicated patrol system for the JDZ. Currently collaborating with FDN to establish such
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Indirect monitoring through provision of scientific information to State parties
NIOMR Nigeria	Indirect involvement through annual surveys confined to Nigerian waters
Independent Stakeholder	Indirect role but believe in designing and institutionalising permanent collective stakeholders' monitoring

### 6.3.5 Direct involvement with JDZ fisheries by stakeholders departments

Participants from the JDA were unanimous in their assertion that the NHR department is the one with direct involvement with the JDZ fisheries among its four departments. This was also confirmed by participants from its liaison office in STP but with the addition that the M&I department too has potentially significant involvement as its foremost monitoring unit.

In the NBC, it is the Department of Maritime Boundaries and Geo-informatics in conjunction with the Director-General's office that could be said to have a direct involvement with the JDZ fisheries management. Other participants from the NBC added Department of Research and Policy Analysis as another with a direct involvement perhaps for its role in the conduct of periodic and circumstantial surveys.

Analysis of the data from the Fisheries Department of Nigeria revealed that two departments namely; the monitoring, control and surveillance and the marine industrial fisheries department are statutorily the ones with a direct involvement with the entirety of Nigeria's EEZ fisheries including part of the JDZ. They were however quick to reiterate the lack of inter-agency cooperation between them and the JDA. Another point worthy of note is that the JDZ cuts across the countries' EEZs and as such any single department or agency from any of the countries may not be able to exercise a complete control over the JDZ activities. This may as well further give credence to the JDA's intention of considering application for encroachment into the two countries' EEZs for ease of licencing as well as for curbing potential problems of transboundary concerns. This was revealed by the ED NHR in the interview when he mentioned 'the resources we have there as fisheries are mainly migratory however and are mainly tuna....and.....it will be difficult for us to licence this.....small area....for the ...eh....for the fisheries companies.....because if the resources are migratory fishes, then before they will catch it, it may be in either of the two countries EEZ. So what we intend to do is that...eh...we contact the two countries to see if we can do a sort of a unified licencing system from the Nigerian

and Sao Tome & Principe's sides to kind of enlarge the area of the fishing licence to be covered by our potential licencing system'.

Although evidence obtained from STP fisheries department revealed consistent lamentation of the lack of cooperation between them and the JDA over the activities of the JDZ, participants observed that the division of industrial fisheries is supposed to be the unit that should have a direct involvement with the JDZ fisheries.

The eastern naval command coordinated by the training and operations branch of the Nigerian navy is the unit that has a direct involvement with the JDZ activities even though its jurisdiction does not extend beyond the country's EEZ. Whereas, the Productivity Centre revealed that the fish & fishery RAC of the GCLME was to be directly involved with the JDZ fishery but as asserted in Section 5.2 the RACs have since closed business due to funding and counterpart funding issues.

It is the Marine Biology Section of the Fisheries Resources Department that is directly involved with the JDZ fisheries within the NIOMR. The independent participant was however of the view that the forestry and biodiversity department of the Nigerian federal ministry of environment should be directly involved since the GCLME desk of the country is domiciled there. It was also observed that as an independent stakeholder, NGOs and CBOs are to be co-opted to represent civil society's interests in the JDZ fisheries, and as such should be the ones with a direct involvement.

Departments responsible for the direct involvement with the JDZ fisheries within various stakeholder organisations are itemised in Table 6.4:

Table 6.4: List of stakeholders' departments directly involved with the JDZ fisheries (Source: Author's own)

Stakeholders	Department responsible for direct involvement with the JDZ fisheries
The JDA	The Non-Hydrocarbons Department
NBC Nigeria	Maritime boundaries and Geo-informatics Department
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Monitoring, Control and Surveillance Department and Marine Industrial Fisheries Department
Fisheries Department of the STP	Division of Marine Industrial Fisheries
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	The Eastern Naval Command under the Training and Operations Command
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Fish & Fishery RAC
NIOMR Nigeria	Marine Biology Section of the Fisheries Resources Department
Independent Stakeholder	Through NGOs and CBOs

## **6.4 Management policies adopted for JDZ fisheries**

This section was designed to collect information on the conceptualisation and design of management policies in place for the sustainability of marine fisheries by the stakeholders. The following sub-sections are the analysed results from surveys in relation to stakeholders' fisheries policies, objectives of stakeholders' fisheries policies, processes and procedures for policy adoption, stakeholders' policy divergence and convergence with other stakeholders, stakeholders' most effective areas of JDZ fisheries management and stakeholders' ineffective areas of JDZ fisheries management.

### **6.4.1 Stakeholders' JDZ fisheries policies**

Results from the analysed data revealed the JDZ fisheries policies by the JDA comprises of development of the fishery as an alternative source of revenue and job creation for the citizens of the two countries. Another is to ensure that code of conduct for responsible fishing is adhered to in the JDZ fisheries exploitation. Other policies include making concerted efforts to develop the fisheries resources through an efficient and sustainable approach, issuance of licences to firms operating a fishing vessel with specification on vessel sizes and other relevant requirements in line with best practices.

The NBC does not have specific fisheries policy for the JDZ but as an agency of government; it does subscribe to the Nigeria's fisheries policy as contained in the National Fisheries Act. It also subscribes to the JDA's fisheries policy as a member of the JMC to which the JDA is answerable.

There are three basic fisheries policies relating to Nigeria's EEZ by the Fisheries Department of Nigeria which includes a substantial part of the JDZ. These are to ensure conservation and sustainable utilization of the fisheries resources, to protect the marine environment and to comply with various international protocols, codes and conventions relating to the fisheries resources management as well as to ensure rational exploitation of the resources, modernise production, storage, processing and marketing. These policies are also aimed at accelerating research in addition to adopting new and appropriate techniques.

In STP however, participants revealed that while sustainability forms the backbone of every fishery, information should first be exchanged first about the JDZ fisheries resources management followed by reinforcement of technical and organisational capacity before it can have a clear policy direction for the JDZ fisheries. This confirmed the recurring perception of negligence by the STP Fisheries Department as observed earlier in Section 6.3.5 and in previous discussions.

Whereas in the Nigerian Navy, the JDZ fisheries policies are based on its standard operating procedures to ensure the sustainable harvest of the Nigeria's waters fisheries in line with the provision of UNCLOS. This is carried out by ensuring that artisanal fishing grounds are protected from incursions by industrial concerns covering from 0 to 13nm. Another policy of the Nigerian Navy is the arrest and confiscation of the vessels that are found to be engaging in IUU fishing, checking and enforcing compliance with fisheries licencing requirements within the Nigerian EEZ. They did however lament their inability to cover the entire EEZ due to lack of requisite modern equipment needed for such tasks.

The main fisheries policies for the GCLME project when it was in operation were to ensure the conduct of continuous regional fish stock assessments, joint productivity surveys and harmonisation of regional fisheries policies among member States. However, as mentioned earlier the entire GCLME project has since stopped operations due to the previously mentioned reasons in Section 5.2.

The NIOMR policies are for the Nigerian waters and are the rational exploitation, conservation and utilization of marine resources for the entirety of the nation's EEZ which does not cover the whole of the JDZ. Participants however reiterated the absence of a working relationship or synergy to warrant having specifically designed JDZ fisheries policies. This may perhaps be through enacting relevant legislations to justify any potential encroachment into each of the country's EEZ considering the transboundary nature of marine resources as already championed by the JDA so that issues of sovereignty incursions could be curtailed.

The independent participant does not seem to have any specific policy towards the JDZ fisheries but subscribes to any policy that aims at sustainability so as to

guarantee continuous provision of the fishery resource and ensure health of the ecosystem.

Individual stakeholder's adopted policies for the JDZ fisheries are as visualised in Table 6.5:

Table 6.5: Summary of stakeholders' JDZ fisheries policies (Source: Author's own)

Stakeholders	Summary of adopted JDZ fisheries Policies by Stakeholders
The JDA	Alternative source of revenue, Job creation and Compliance with treaties, statutes and conventions
NBC Nigeria	Unspecified; but subscribes to the National Fisheries Policy as an agency of Government
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Conservation and protection of the fishery resources. Sustainable utilization and exploitation of the resources and compliance with various international protocols, codes and conventions to which Nigeria is a signatory to
Fisheries Department of the STP	Unclear yet, awaiting the formulation of a strong and functional partnership before enactment
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	By adhering to standard operating procedures which guarantee sustainable harvest of Nigerian waters fisheries in line with provision of UNCLOS. Ensuring continued protection of artisanal fishing grounds against incursions by industrial concerns.
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Continuous regional surveys, assessments and harmonisation of regional fisheries policies among member States
NIOMR Nigeria	Rational exploitation and conservation of fisheries resources. Enactment of relevant legislations
Independent Stakeholder	Unspecified policy but subscribes to any policy aimed at ensuring sustainability to ensure ecosystems' health

#### 6.4.2 Objectives of stakeholders' fisheries policies

There were six clearly stated objectives of the JDA's fisheries policies obtained from the analysed survey data, and these are (1) to give clear understanding of the enormous fisheries availability within the JDZ (2) to generate revenues for the two parties and improve their economies in addition to developing the fisheries itself (3) to seek and obtain an extension for encroaching into each of the nation's EEZ so as to attract credible investors (4) to ensure sustainable exploration and exploitation of the fishery resources in an ecologically and environmentally friendly manner (5) to determine the fishery resources of the zone and grow the fishing industries of the two State parties; and (6) to engage third parties with proven capability to explore.

The objectives of the NBC as an indirect stakeholder as revealed from the survey analyses are to ensure sustainability of the maritime zone of Nigeria in line with the Sea Fisheries Act and provide appropriate guidance and co-ordinates in relation to delimitation of the nation's maritime boundaries. These would in turn ensure stabilisation and protection of the marine ecosystem in general in addition to minimising potential conflicts that may arise from boundary delineation as well as apportionment of fishing rights to potential investors when quotas and licences are allocated.

Objectives of the fisheries department of Nigeria's fisheries policies are in line with the prevailing regional approaches to fisheries resources management policies (Garcia & Cochrane, 2005; Rice & Rochet, 2005; Beliaeff & Pelletier, 2011). As the main regulator of Nigeria's fishing industry, its fisheries policy objectives cover the entire EEZ of the country and includes significant portion of the JDZ. One objective is to achieve optimum socioeconomic benefits thereby improving fisheries governance in line with other Regional Fisheries Management Organisation's (RMFO) policies. Another is to create an enabling environment for the sustainable development of the Nigeria's fisheries resources so as to attain self-sufficiency and create avenues for exports.

The Fisheries Department of STP does not seem to have clear policies for the JDZ fisheries currently due to lack of synergy between them and the JDA management and the persistent perception of negligence by the JDA as observed in Sections 6.3.5 and 6.4.1. However, it was revealed that its objectives for the JDZ fisheries would most likely take the form of promoting the economic activities of interest to both State parties.

Analyses of the survey data from the Nigerian Navy revealed that the objectives of its JDZ fisheries policies are to guarantee general maritime security of the Nigerian waters, ensure a safe corridor for the legitimate fishing community to function and contribute to national development. This is in addition to ensuring the security of the entire Nigeria's EEZ and check IUU fishing prevalence.

Whereas policy objectives for the JDZ fisheries by the Productivity centre of the GCLME as revealed from analyses of the survey was to fill gaps in knowledge, to designate, conserve and protect habitats. Others are to develop and agree on management plans, to develop and implement regional biodiversity strategies between and among GCLME member States while the project was in operation.

The main objectives of the NIOMR as Nigeria's foremost marine research institute are the determination of abundance, distribution and biology of aquatic resources for the entirety of Nigerian waters which covers a good portion of the JDZ but does not include the STP component of the zone. This and other reasons attested to in previous sections may have been the justification on why the JDA is considering seeking for permission to enter into each of the nation's EEZs for ease of licencing and for consolidating investor confidence due to the nature of transboundary marine fishery resources.

The independent participant also revealed that the objective of any fisheries policy would be to ensure the sustainability of the resource and guarantee the health of the ecosystem in which the fishery resources inhabit.

A summary of the objectives of stakeholders' JDZ fisheries policies as obtained and analysed from the survey data is as visualised in Table 6.6:

Table 6.6: Summary stakeholders' objectives of the JDZ fisheries' policies  
(Source: Author's own)

Stakeholders	Objectives of Stakeholders' JDZ fisheries policies
The JDA	Resource availability awareness, revenue generation, resource development, sustainable exploration and exploitation of resource and engagement of capable third parties
NBC Nigeria	Sustainability and delimitation of maritime zones, stabilisation and protection of the marine ecosystem and provision of fishing coordinates
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Achievement of optimum socioeconomic benefits thereby improving governance
Fisheries Department of the STP	Promotion of economic activities of interest to both State parties
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Provision of safe corridor for legitimate fishing concerns and general maritime security
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Filling knowledge gaps, designation, conservation and protection of habitats
NIOMR Nigeria	Determination of abundance, distribution and biology of aquatic resources for Nigerian waters
Independent Stakeholder	Resource & ecosystems health sustainability

### 6.4.3 Processes and procedures for policy adoption

Although the JDZ fisheries are yet to be fully developed as revealed from the analysed survey, there are in place policies and procedures already adopted as well as their objectives of such as revealed in the previous sections. In the process of developing the JDZ fisheries policies, the JDA are relying on the significant experience of STP being an archipelago and a small island State whose economy is and has always been dependent on marine resources including fisheries. The JDA conducted a preliminary survey in 2012 in conjunction with the FAO and the Norwegian Institute of Marine Research to have an idea about the nature and abundance of the JDZ fisheries. There is currently an intention to involve independent experts for procedures and advice on licencing and negotiation. It is also considering collaboration with the NIOMR and the fisheries departments of the two States. This confirmed the assertions by the mentioned stakeholders and consistently re-echoed in the surveys on the lack of working relationship between the JDA and critical stakeholders. This will be followed by conducting stakeholder inputs (investors) analysis and the evaluation of the viability of the policies and proposals. Furthermore, the JDA intends to engage and potentially harmonise the two State parties' individual fisheries policies.

The main policy and procedure adopted by the NBC is through the provision of policy guidance and direction as a member of the JMC; to which the JDA is answerable to and seek approval from on policy implementation.

The Fisheries Department of Nigeria in adopting Nigeria's fisheries policies emphasised following environmentally friendly techniques and technologies capable of maximising benefits in addition to ensuring sustainability of the resources (Beliaeff & Pelletier, 2011). It also wholly adopted and is signatory to the FAO code of conduct for responsible fisheries (Falaye, 2008).

Analysis of the data from the STP fisheries department revealed that participants were not privy to the processes and procedures for the adoption of JDZ fisheries' policies as they have not been carried along on the activities of the JDZ because all activities of the JDZ have been under the control of the STP's foreign affairs

department. This was also later to be transferred to the natural resources ministry depicting continuous movement of and inconsistencies in delegating responsibility between and among agencies of government as earlier observed Section 6.3.2.

The processes and procedures followed by the Nigerian Navy in adopting the Nigeria's EEZ fisheries' policies which include part of the JDZ as revealed from the survey are information sharing, enforcement of fishing vessels licence compliance to the use of approved nets, ensuring due processes are followed and avoidance of unauthorised areas by licenced practitioners.

The analysis of the data from Productivity centre of the GCLME revealed that the centre was primarily concerned with the productivity aspect of the GCLME project and that processes and procedures followed for adopting the GCLME fisheries policies were to be found with the Fish & Fishery RAC of the GCLME in Angola. This RAC was found to have a similar fate to the other RACs due to reasons explicitly discussed in the previous sections.

The NIOMR serves an advisory role based on its findings from periodic research within the Nigerian waters which may include a part but obviously not the whole of the JDZ and disseminates such research findings either on request or on periodic symposia to relevant stakeholders. Whereas independent stakeholder's analysis of responses indicated that there is no known process and procedure for adopting JDZ fisheries policy except in subscribing to the concept of sustainability which is usually done either through consultancy services offered in line with global best practices or through awareness campaigns aimed at resource users. And this is done mainly in an advisory capacity as independents usually lack enforcement powers.

Table 6.7 summarises the processes and procedures followed by stakeholders for adopting their JDZ fisheries policies:

Table 6.7: Summary of procedures followed by stakeholders' for JDZ fisheries policies adoption (Source: Author's own)

Stakeholders	Processes and procedures for adoption of JDZ fisheries policies
The JDA	Reliance on STP experience, engagement of independent experts, preliminary surveys, engagement and harmonisation of individual State parties fisheries policies
NBC Nigeria	Policy direction and guidance as a member of the JMC
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Whole adoption and signatory to the FAO code of conduct, emphasis on adoption of environmentally friendly techniques for maximisation of benefits and sustainability
Fisheries Department of the STP	Not privy to such as there is no working synergy despite its critical significance
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Information sharing, enforcement of fishing vessels licence compliance, due process conformity and ensuring the avoidance of unauthorised areas
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Concerned mainly with productivity when in operation, processes & procedures lie with F & F RAC
NIOMR Nigeria	Serves an advisory role through disseminating research findings to relevant parties
Independent Stakeholder	Subscription to sustainability through consultancy services in line with global best practices-Mainly in advisory capacity without enforcement rights

#### **6.4.4 Policy divergence and convergence with other stakeholders**

Analysis of the data from the JDA revealed no known policy divergence or convergence at this stage due to the current stage of the fishery. When fully developed and operational, it will have more of convergence than divergence so as to be in line with other relevant stakeholders' policies for the common benefits of all parties and for sustaining the resources as well as the ecosystems health.

Data from the NBC however revealed the existence of a policy convergence in areas of wanting to tackle common threats to fisheries between the two nation States such as in combating IUU fishing. This is a well-known threat to the entire Gulf of Guinea (Ukwe et al., 2003; Ukwe, Ibe & Sherman, 2006; Falaye, 2008; Ukwe & Ibe, 2010). It also revealed a divergence with other interested parties engaged in nefarious activities such as the parties engaged in sea piracy and IUU fishing. As these concerns are very formidable and organised and usually corruptly engage regulatory officials either through intimidation or outright bribery.

The Nigerian Fisheries Departmental policies have been found to be in convergence with the policies of some regional bodies such as the Fisheries Committee of the West and Central Gulf of Guinea (FCWC) in the areas of collaboration regarding the management of shared marine stocks. It was also found to be in convergence with other Regional Fisheries Management Organisations (RFMO) and international organisations such as International Council for the Conservation of the Atlantic Tuna (ICCAT). There were no observable areas of policy divergence with other stakeholders from the Fisheries Department of Nigeria's policies.

On the contrary, analysis of the data from the STP Fisheries Department participants revealed that the department is unaware of the JDZ policies for it to compare and deduce level of convergence or divergence. This perceived isolation by the STP as observed in several previous sections was also equally re-echoed when it was revealed that the department has been reporting its concerns on the non-inclusion in the overall activities of the JDZ fisheries.

Interestingly, findings from the Nigerian Navy from both the interview and the questionnaire responses revealed a significant divergence of policies in areas of

information sharing between them and the Nigeria Trawlers Owners Association. The Navy consistently accused them of not being forthcoming with information regarding their operations and in consistently changing their fishing area locations claiming that the fisheries resources are in continuous movements. These inconsistencies make it very difficult for the Navy to dedicate its resources to a particular location in their fight against incursions and piracy. Conversely, there appeared to be some areas of policy convergence with other stakeholders such as the fisheries department in issues of support for national objectives on food security and environmental safety.

Data from participants in the former Productivity centre revealed that since all the modules of the GEF LME indicators were designed and aimed to assess the marine environment as a whole then there could not be any area of divergence from any of the centre's policies with other stakeholders' policies. As such, all other stakeholders' policies could be said to be in convergence with the centre's policies towards the entire GCLME region; which includes the JDZ as well.

Data analysed from the NIOMR revealed that participants strongly believe that there could be an area of convergence in certain areas. These include the need for sustainability of the ocean's resources and in maintaining health of the marine ecosystem. It was also observed that the institute does not have any working relationship or collaboration with the JDA and as such cannot identify areas of convergence or divergence. This further confirmed the JDA's management inability to reach out to important and critical stakeholders for building and maintaining necessary partnerships for mutual benefits of those concerned. It further confirmed the perception of alienation as frequently revealed by other critical stakeholders such as the fisheries department of the STP and others.

There was no evidence of policy generation by independent stakeholders to warrant policy convergence or divergence comparisons apart from their subscription to sustainability concept in conventions.

A summary of stakeholders' policies convergence and divergence with other stakeholders are as visualised in Table 6.8:

Table 6.8: Overview of stakeholders' policy convergence & divergence with others  
(Source: Author's own)

Stakeholders	Policy convergence and divergence with other stakeholders' policies
The JDA	No known convergence or divergence currently due to the stage of the JDZ fisheries, expected more of convergence when fully operational
NBC Nigeria	Convergence in areas of tackling common threats and divergence with piracy and IUU fishing practitioners
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Convergence in areas of collaboration with RFMOs such as FCWC and ICCAT regarding management of shared marine stocks while no areas of divergence were identified
Fisheries Department of the STP	Unable to identify areas of convergence or divergence as they are unaware of the fisheries activities within the JDZ
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Significant divergence with Trawlers Owners Association for not sharing information, convergence with fisheries department in issues of support to national objectives on food security and environmental safety
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Overall convergence as all modules of the GEF LME indicators aims to assess marine environment as a whole when it was operational
NIOMR Nigeria	Strongly believe in convergence in areas of the need for sustainability of the resources and the ocean's health
Independent Stakeholder	No evidence of individual policy generation to warrant comparison but subscribes to concept of sustainability

#### **6.4.5 Most effective areas of organisation**

The analysis of the data from the JDA revealed that participants were of the opinion that some of the most effective areas in which the JDA has been most effective include the conduct of the preliminary marine survey in conjunction with the Norwegian Institute of Marine Research and in the attraction of potential international investors. The survey was commissioned by the JDA management in order to assess stocks, identify seabed minerals and determine the commercial viability of the fishery resources within the JDZ. Potential investors were attracted when the JDA organised a workshop to disseminate initial findings of the survey where a promising potential for the JDZ fishery resources was disclosed based on the survey.

The area in which the NBC as an organisation could be said to be most effective was found to be in establishing Nigeria's territoriality and in the delimitation of the JDZ. This was manifested in its role as the foremost agency of government that spearheaded the negotiations that ultimately led to the delineation and designation of the JDZ in conjunction with STP partners.

Survey results from the analysis of the data obtained from the Fisheries Department of Nigeria indicated some areas the participants believed the department was most effective at. These include putting in place access control through the issuance of licences to the Nigerian flag-registered shrimping and fishing vessels, enforcement of fishing gear control through the regulation of mesh sizes of fishing nets and by conserving endangered species through the use of turtle excluder devices. Others are enforcement of by-catch reduction devices and mechanisms so as to ensure quality control. This is in addition to developing national fisheries laboratory activities and shrimping and shrimp exports.

Similarly, the Fisheries Department of STP participants' opinions revealed strength in artisanal, semi-industrial and industrial fisheries management as the area in which it has been most effective at as an organisation.

The Nigerian Navy participants' analysis of the data revealed that participants were of the opinion that the navy has been most effective in the arrests of several IUU

fishing vessels particularly those from Chinese flagged vessels as well as in the provision of security and enforcement of Nigeria's fisheries laws such as the Sea Fisheries Act 2011.

Analysis of the data from the Productivity centre revealed participants' opinions to be cooperation and collaboration among the GCLME countries when the project was in operation as the most effective area of the centre. This was followed by assisting member States in capacity building and stock assessment. The centre used to collect and collate data that depicted different scenarios for the GCLME such as sea surface temperature trends.

Spearheading the Nigeria's National Fisheries Policy review of 2013 that led to the enactment of the Sea Fisheries Act was revealed as the area in which the NIOMR was most effective, based on the analysis of the data from its participants (Rice & Rochet, 2005; Potts, 2006). This is in addition to assisting in the provision of periodic marine fisheries resources data for the Nigerian waters to other relevant agencies and other stakeholders on request. Another area where the NIOMR has been most effective is in conducting marine fishery research for the Nigerian waters with the aim of informing the Nigerian government and academia on the resource situations and abundance.

There are no observable independent stakeholder's individual or particular areas of strength other than in the provision of consultation services to interested agencies, firms or organisations.

A summary of stakeholders' areas of effectiveness as revealed from the survey is presented in Table 6.9:

Table 6.9: Summary of stakeholders' most effective areas in JDZ fisheries management  
(Source: Author's own)

Stakeholders	Most effective areas of marine fisheries management
The JDA	Conduct of the preliminary marine survey and attraction of international investors
NBC Nigeria	Establishment of Nigeria's territoriality and delimitation of the Nigeria-STP JDZ
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Access control through issuance of licences, enforcement of fishing gear control, conservation of endangered species and by-catch reduction devices
Fisheries Department of the STP	Strength in artisanal, semi-industrial and industrial fisheries management expertise
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Apprehension and arrests of several illegal operators such as IUU fishing fleets and in the provision of security and enforcement of Nigeria's fisheries laws
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Cooperation and collaboration among member States, provision of capacity building and stock assessment and also collection and collation of data to depict scenarios
NIOMR Nigeria	Spearheaded the National Fisheries Policy review 2013, assists in provision of marine fishery resource data for the Nigerian waters
Independent Stakeholder	No evidence of individual area of strength but provides consultancy services to interested stakeholders as an expert

#### 6.4.6 Ineffective areas of organisation

Analysis of the data from the JDA participants revealed several areas where the JDA has been ineffective in terms of managing the JDZ marine living resources. These include the inability of the JDA to obtain data from either of the State parties, inability of the JDA to provide adequate security to the JDZ marine fishery resources against IUU fishing, inability of the JDA to attract credible and serious investors so far and inability of the JDA to commence fisheries economic activities after over 10 years of commencement of operations in the JDZ. This confirmed an earlier assertion by the Chairman of the JDA board in Section 6.3.4 that much attention has always been to the hydrocarbons resources of the JDZ to the detriment of the marine living resources, largely due to the desire for quick returns and negligence of the health of the marine ecosystem.

Data from the NBC participants indicated that since the NBC does not have any direct involvement in the JDZ fisheries management, it will be difficult to identify where or in which areas it is ineffective in terms of managing the JDZ fisheries. Participants were quick to add however that the NBC as the custodian of the nation's maritime boundaries can contribute in proffering scientific solutions to problems of piracy and IUU fishing when required to do that.

In the Fisheries Department of Nigeria, some of the areas it is ineffective as revealed from the survey data include their inability to establish an effective Vessel Monitoring Service (VMS) and fishing patrol vessels. Others are their inability to effectively curb sea piracy, robbery, tuna exploitation and IUU fishing as well as their lack of expertise in management of deep sea resources.

Similarly, the STP fisheries department also identified inability to control IUU fishing activities within the STP fringes as the most important area it is most ineffective at from the survey data. This, they attributed to lack of capacity despite being an archipelago whose economy has always been dependent on fishery resources and due to their small size making it difficult to afford modern piracy equipment. Their size also appeared to make them feel vulnerable to such threats even when it is obvious illegal activities within their waters occur unabated.

What was continuously and collectively emphasised by all the Nigerian Navy participants from the survey was the navy's inability to procure dedicated anti-IUU fishing patrol vessels. Despite its apparent success in the apprehension of IUU fishing and other illegal sea activities within the Nigerian waters, the navy does not have in place a dedicated unit for fighting IUU fishing activities. Most of its successes were as a result of the efforts of their general maritime patrol fleets; which are mostly deployed for safeguarding the nation's territorial waters and mostly for curbing the prevailing oil thefts at sea. Other areas identified by the Nigerian Navy include their inability to establish harmonious working relationship with the trawlers owners association as well as in their inability to manage shared information that may lead to quick responses to prevent attacks on legitimate fishing vessels from pirates (Rice & Rochet, 2005; Falaye, 2008; Gaichas, 2008).

Although the Productivity Centre and the other Regional Activity Centres (RACs) of the GCLME project have all folded up due to lack of funding as observed in previous sections, data from the participants revealed that lack of proper synergy between the RACs when they were in operation was the most important area where the centre could be said to be ineffective. This was in addition to its inability to ensure effective monitoring and enforcement of regulations agreed between and among member States.

The most important areas where the NIOMR was largely ineffective were in their inability to maintain continuous monitoring for the provision of an up to date and reliable data as a foremost Marine Research Institute and lack of sufficient sea going vessels for conducting research.

Areas of ineffectiveness identified by the independent participant were in the inability of the civil society to create sufficient awareness of marine activities among the general populace and also in engaging resource managers. This impedes the ability to ensure virile stakeholder participation as well as in providing checks and balances.

Identified areas of ineffectiveness by stakeholders in managing marine fishery resources as revealed from the analysed data is summarised in Table 6.10:

Table 6.10: Summary of areas stakeholders' were ineffective at for JDZ fisheries management  
(Source: Author's own)

Stakeholders	Most ineffective areas of marine fisheries management
The JDA	Inability to obtain data from State parties, Inability to safeguard against IUU fishing, inability to attract credible investors and inability to commence fisheries activities after over 10 years of operations of the JDZ
NBC Nigeria	Does not have direct involvement, but can proffer scientific solutions in combating IUU fishing when required as the custodian of Nigeria's maritime boundaries
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Inability to establish effective VMS and fishing patrol vessels, inability to effectively curb sea piracy and robbery
Fisheries Department of the STP	Inability to control IUU fishing activities on the STP fringes due to lack of capacity despite its abundance
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Lack of dedicated anti-IUU fishing patrol vessels, lack of harmonious working relationship with trawlers owners and inability to manage shared information for quick responses
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Lack of proper synergy between the RACs when they were in operation, inability to ensure effective monitoring
NIOMR Nigeria	Inability to maintain continuous monitoring for the provision of an up to date and reliable data due to lack of dedicated sea going vessels for research
Independent Stakeholder	Inability to mobilise civil society for virile stakeholder participation, inability to provide checks and balances

## **6.5 Nature of fishing within the JDZ**

This section was designed to collect information on the nature of fishing within the JDZ and the management regime in place to sustainably manage it from the identified stakeholders' point of view and knowledge. The following sub-sections are the analysed results from surveys in relation to the JDZ management regime in existence, legitimate practitioners responsible for the regime, existence of a licencing or quota system, contribution to ensure JDZ fisheries sustainability and relevant stakeholders that should be involved based on stakeholders' opinions.

### **6.5.1 JDZ management regime in existence**

Data obtained from the JDA indicated that the JDZ fisheries management regime is still in the process of being established and as such no fishery management regime exists currently for the JDZ. However, it is envisaged to be a licencing regime and/or joint venture partnership when it commences. This was also attested to by the ED NHR during the interview when he mentioned '...the regime is yet to be established as we are in the process of establishing one; perhaps the outcome of your research may assist us towards that' and also the chairman of the board when he mentioned that '..as explained to you earlier and as you may well be aware that ...we feel guilty of not developing the fishery after over a decade of the JDZ operations because we have all been dedicating our energies towards the oil and gas....that is the truth; but as I said serious attention is currently being paid towards developing the fishery resources'.

Participants from the NBC were unaware of the existence of any fishery regime currently for the JDZ, but are aware of the on-going process of establishing one as a member of the JMC.

Similarly, respondents from the Fisheries Department of Nigeria are unaware of what regime exists for the JDZ fisheries due to lack of cooperation and collaboration. However, for the Nigerian waters, there is a management plan adopted for the industrial fisheries which is in line with national fisheries laws as well as international fisheries conventions for the Nigeria's EEZ (UN, 2001).

Furthermore, respondents from the fisheries department of STP are unaware whether or not a regime for the JDZ fisheries exists as they have not been involved or informed about the JDZ activities. Similarly, respondents from the Nigerian navy are unaware of the kind of fishery regime that operates within the JDZ because it has no direct involvement with its management and have not been briefed about plans towards that.

Although there was in place fisheries management plan for the GCLME region during the lifespan of the project, participants from the Productivity centre are not aware of the existence of any JDZ specific fishery regime.

Participants from the NIOMR however revealed the existence of a regime for the Nigerian waters which includes a part but not whole of the JDZ. The regime consist of input control, vessel registration and licencing but were equally quick to add that they are aware that the JDA is yet to establish any regime for the JDZ fisheries and that they are in the process of establishing one soon.

Disclosure by the independent stakeholder during the survey further reiterated the absence of stakeholder engagement and awareness as complete ignorance of the existence of JDZ fisheries regime and the process of establishing one was claimed.

Table 6.11 summarises the disclosures by different stakeholders on the status of the JDZ fisheries regime as revealed from the data:

Table 6.11: Summary of stakeholders' disclosures on the status of the JDZ fisheries regime  
(Source: Author's own)

Stakeholders	Disclosure on the status of the JDZ fisheries regime by the stakeholders
The JDA	No regime in existence as requisite attention has always been on hydrocarbons but regime is in the process of being developed currently
NBC Nigeria	Not aware of existence of regime but aware of current process of building one as a member of the JMC
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Aware of Nigerian waters regime in form of a management plan but unaware of specific JDZ regime
Fisheries Department of the STP	Unaware whether or not a regime for the JDZ fisheries exist
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Unaware of the kind of fishery regime that operates within the JDZ because it has not been involved
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	While fisheries management plan exists for the GCLME region, the centre is unaware of JDZ specific regime
NIOMR Nigeria	Aware of a regime for Nigerian waters; which consists of input control, vessel registration and licensing but specific JDZ regime in the process of being established
Independent Stakeholder	Completely unaware of JDZ fisheries regime, appeared to assume JDZ fisheries not under the JDA's mandate

### 6.5.2 Legitimate practitioners that should be responsible for the regime

Results from the JDA participants revealed that almost all the respondents are of the view that the JDA should be the only legitimate practitioner responsible for the JDZ fisheries regime when it comes into existence. A few included some international organisations such as the FAO and the Norwegian Institute of Marine Research in addition to the JDA. This unified standpoint confirmed other stakeholders' perception of neglect in the overall management of the JDZ resources as revealed in the previous sections.

Analysis of the data from NBC depicted varied responses from across the range of participants. While Directorate cadre participants believe that practitioners should include or be composed of only the JMC members, middle management cadre participants believe it shall in addition to the JMC members include the fisheries departments of the two countries and the civil society.

Participants from the Fisheries Department of Nigeria are of the view that while it appeared difficult to involve agencies and organisations from both countries without possibly neglecting some others, it is important that the maritime police, the navy and NIMASA on the Nigerian side as well as their counterparts from the STP should be involved. However, this is where the problem will arise especially when the same or similar agencies of government in one country do not exist in the other. This was highlighted in Section 5.4.1 when it was discovered in the course of this survey that STP does not have a standing Boundary Commission such as found in Nigeria and that STP does not equally have a standing naval force as found in Nigeria. What was observed in STP is an ad-hoc committee that is usually set up periodically whenever there are boundary issues to deal with and disbanded when it is solved. STP also does not have a standing navy but a small coastguard unit.

It was however revealed from the analysis of STP fisheries department's data that all the ministerial and governmental departments directly and indirectly related to marine affairs should be involved; reflecting their consistently held view of being neglected in the overall management of the JDZ resources.

Whereas, the Nigerian navy participants believe that legitimate practitioners should involve the National Trawlers Owners Association, NIOMR, NIMASA and the fisheries departments from the two countries. Participants from the Productivity centre were however not aware of who should legitimately be involved for the JDZ regime because the centre was/is not in any way involved with the JDZ fisheries management.

Results obtained from the NIOMR revealed that participants were of the view that legitimate practitioners should involve the Department of Petroleum Resources (DPR), Nigerian National Petroleum Corporation (NNPC), Nigerian Ports Authority (NPA) and the fisheries departments of the two countries. These, they added shall be in conjunction with their counterparts from the STP; whereas not all the agencies mentioned have counterparts in the STP as observed earlier in this section.

The independent participant's data similarly revealed that legitimate practitioners should involve the NIOMR, Department of Fisheries from the two States, the civil societies operating in the two States, community based organisations from the two States and the non-governmental organisations.

A summary of the stakeholders' opinions on the legitimate practitioners that should be involved is presented in Table 6.12:

Table 6.12: Stakeholders' opinions on the ideal legitimate practitioners for JDZ fisheries  
(Source: Author's own)

Stakeholders	Opinion on legitimate practitioners that should be responsible for the JDZ marine fishery regime
The JDA	Only the JDA in conjunction with FAO & Norwegian Institute of marine Research
NBC Nigeria	The JMC members and the fisheries department of the two countries and the civil society
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Maritime police, the Nigerian Navy and their counterparts in the STP
Fisheries Department of the STP	All ministerial and governmental departments directly and indirectly related to marine fishery affairs
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	National Trawlers Owners Association, NIOMR, NIMASA and the two nations' fisheries departments
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Unaware of who should be involved as they were in no way involved with the JDZ specifically
NIOMR Nigeria	The DPR, NNPC, NPA and the fisheries departments of the two States
Independent Stakeholder	NIOMR, CBOs, NGOs and the two countries fisheries departments

### 6.5.3 Existence of a licencing or quota system

There is no licencing and/or quota system in place at this stage for the JDZ fisheries, but it is envisaged that the fishery regime being planned currently is expected to be made up of a licencing and quota system allocation. This was revealed both in the interviews and the administered questionnaires from the JDA. It was also revealed that the JDA will soon commence licencing of competent operators when their preliminary survey data is analysed and triangulated with inputs from Fisheries Department of the two countries. These processes are part of the plan discussed earlier in Section 6.3.5 where the ED NHR disclosed the intention of the JDA to apply for permission for encroachment into any of the two States' EEZs for ease of licencing and for foreclosing potential disputes over transboundary marine fisheries. The process was further highlighted by the Chairman of the Board when he mentioned that 'Ok....ah.....actually we have some work done on that.....but we didn't come to that stage yet because we have not issued a licence or allocated any quota yet.....to say that we have a licence or quota for this and that area. So this is part of the whole process we have been talking about during the interview'.

Results from participants from the NBC however revealed that while the executive participants made up of the directorate staff are aware of the plan and process of establishing a licencing and quota system for the JDZ fisheries, non-executive participants made up of members of staff in the mid-management cadre are not aware of the existence of any such plan and even of the intention to initiate such a plan by the JDA.

There is in place a licencing system for the Nigerian waters for shrimping and fishing vessels operating within its EEZ however, it does not cover whole of the JDZ as the JDZ traversed across two countries' EEZs. Participants from the Fisheries Department of Nigeria are not aware of any licencing or quota system specifically designed or in operation for the JDZ. This was revealed by the data analysed from the Fisheries Department of Nigeria and this is unarguably one of the reasons why the JDA participants felt the need to apply for encroachment of the two countries' EEZs beyond the size of the JDZ. The permission is also meant to establish rights for

potential investors who may find it difficult to operate strictly within the JDZ considering the nature of transboundary marine fishery resources.

Similarly, the Fisheries Department of the STP are not aware of the existence of any licencing regime or a quota system for the JDZ fisheries and equally revealed absence of any such for its own waters or EEZ such as revealed by its Nigerian counterpart on the JDZ fisheries component. What prevails in STP as revealed from the data are a series of partnerships shrouded in secrecy the island nation has with several European and Asian nations. These partnerships largely operate around the outer fringes of its own EEZ and beyond the reach of its small-sized and ill-equipped coastguard to regulate, monitor and inspect.

While the Nigerian Navy has been consistent in apprehending illegal fishing and shrimping vessels operating with the Nigerian territorial waters it does not know if a licencing or quota system operates specifically for the JDZ as its mandate does not cover the JDZ completely. It did reveal the existence of a licencing system however operating for the Nigerian waters and lamented the inherent difficulty in licencing operations for quota allocations for the JDZ without encroaching into each of the countries' EEZs.

All the participants from the Productivity centre of the GCLME are unaware of whether or not a licencing and quota system exists for the JDZ fisheries but are aware for several other individual West African nation States' fisheries. This, they revealed has been existing over a long period of time between those nation States and some European and Asian firms (Uitto & Duda, 2002; Ukwe et al., 2003; Uche-Okeke, 2008; Trouillet et al., 2011).

The data from the NIOMR revealed that participants are equally unaware of the existence of any quota or licencing system for the JDZ fisheries but are aware that the JDA is still conducting preliminary surveys with a view to establishing a substantive fishery regime for the JDZ fisheries. While independent participant data revealed awareness for most African countries about a licencing and/or quota system, there was no evidence of awareness for the existence of the JDZ fisheries.

Table 6.13 indicates stakeholders' awareness of the existence of a licencing and/or quota system for the JDZ fisheries as well as position of the licencing and quota system by the JDA.

Table 6.13: Stakeholders' awareness of the existence of a licencing regime for JDZ fisheries  
(Source: Author's own)

Stakeholders	Awareness of the existence of a licencing or quota system for the JDZ fisheries by stakeholders
The JDA	There are no licencing or quota system in place yet, but the JDA is in the process of establishing a regime
NBC Nigeria	Top management aware of the process of establishing a regime while middle cadre officers aren't aware
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Aware of/operates a licencing system for Nigerian waters but not for the JDZ specifically
Fisheries Department of the STP	Aware/operates a partnership with some foreign firms for STP waters but completely unaware of plan and process in place for the JDZ specifically
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Unaware of a system for the JDZ but aware of system for Nigeria and lamented difficulty for setting up JDZ specific system
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Unaware of JDZ licencing system but aware of GCLME States individual licencing systems over a long period
NIOMR Nigeria	Unaware of the existence of JDZ licencing system but aware of the JDA's ongoing surveys aimed at establishing such systems
Independent Stakeholder	Aware of systems for several African countries including Nigeria & STP but unaware of JDZ specific system

#### **6.5.4 Contribution to ensure JDZ fisheries sustainability**

Varied responses were realised from the analysis of the data from the JDA participants on the nature and viability of contribution to ensure JDZ fisheries sustainability. While some participants believe that it is still premature to identify the JDA's contribution to ensure fisheries sustainability; others believe that proper monitoring, constant review of international policies and the conduct of periodic stocks assessment are relevant contributions to sustainability. This is to be in addition to conduct of Environmental Impact Assessment (EIA) of the marine environment so as to study or monitor impact of other adjoining activities such as oil and gas exploration and production and also climate change.

Information obtained from the NBC revealed that it does not directly engage as such but does so in its capacity as a member of the JMC. In this capacity it offers direction in terms of policy formulation for the running of the JDA.

The Fisheries Department of Nigeria contributes to the fishery sustainability by adhering to the management plan for the industrial shrimp fishery of Nigeria based on the department's standard measures of operating procedures. However, for the JDZ specifically, participants' views were that they have not been involved enough to equate their measures or input with the JDA's.

Similarly, participants from the fisheries department of STP believe that as there is not in place a working relationship, collaboration and cooperation between them and the JDA management; it will be difficult to identify where their contributions lie in ensuring the JDZ fisheries sustainability if any.

Analysis of the data obtained from the Nigerian Navy survey indicated that the Navy contributes to the EEZ of Nigeria and the part of the JDZ fishery sustainability by ensuring periodic patrols of fishing zones. It also participates in seminars, workshops, conferences and in the apprehension of Nigeria's EEZ laws offenders.

It was also revealed by participants from the Productivity centre that the centre used to contribute by deploying remote sensing instruments for detection of IUU

fishing activities and for measuring sea surface temperature for the entire GCLME which includes the EEZ of the sixteen countries of the Gulf of Guinea.

The NIOMR on the other hand ensures that it produces reliable and useful data towards the sustainability of Nigerian waters fisheries, but does not have any specific contribution towards the JDZ only. This further confirmed the constraint being consistently mentioned by participants because the JDZ cuts across two sovereign nations' EEZ. This has necessitated the setting up of a body to manage their common resources, but stakeholders' legal and administrative limits are not clearly identified and defined.

The independent stakeholder does not have any specific role directly but does contribute through frequent sensitization campaigns aimed at the citizenry on the need for sustainability of the marine resources especially fisheries for the common benefits of all concerned.

The submission as observed in several other previous sections by executive participants from the main JDZ resource managers-the JDA-on their plan to apply for permission to encroach into each of the two nations' EEZ may have been prompted by the need to simplify the potential legal and administrative lacunae by other stakeholders in the JDZ. While the legal status of the JDZ is explicitly clear from the treaty which vested the JDA with the sole responsibility for management, there are critical stakeholders from across the two countries whose rights and jurisdictions over the administration of the JDZ and its marine fishery resources does not seem clearly defined and straightforward. This is because marine fishery resources are known to be transboundary in nature and can freely move across maritime boundaries without recourse to any subsisting authority (Couper, 1992; Smith, 1992; Sherman et al., 2009; IOC-UNESCO, 2011). Conversely, there are several nationally recognised bodies and agencies from across the two countries that are critical stakeholders in their respective countries' EEZs who may find it difficult to determine their legal and administrative limits as far as JDZ fisheries resources are concerned (Smith, 1991; Smith, 1992; Couper, 1992; Hayashi, 1995; Anderson, 1996; Juda, 1997; Garcia & Hayashi, 2000; Uitto & Duda, 2002).

A summary of stakeholders' contribution to the JDZ fishery sustainability is as presented in Table 6.14:

Table 6.14: Stakeholders' contribution to JDZ fisheries sustainability  
(Source: Author's own)

Stakeholders	Summary of individual stakeholders contribution to the JDZ fisheries sustainability
The JDA	Conduct of periodic stocks assessment, review of international policies and EIA to monitor adjoining activities
NBC Nigeria	No direct engagement except in its capacity as a member of the JMC where it offers policy guidance and direction
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	By adhering to Nigeria's industrial shrimp fisheries management plan based on standard operating procedures
Fisheries Department of the STP	Unclear where contribution lies due to absence of any working collaboration or cooperation between it and the JDA
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Ensuring periodic patrols of fishing zones and by participating in seminars, workshops, conferences and in apprehension of Nigerian fisheries laws offenders
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Deployment of remote sensors for detection of IUU fishing and measurement of sea surface temperatures for GCLME
NIOMR Nigeria	Production of reliable and useful data towards the sustainability of Nigerian waters fisheries
Independent Stakeholder	Sensitization campaigns towards educating the citizenry on the need for imbining sustainability concept for humanity

## **6.6 Nature of IUU fishing around the JDZ**

This section of the survey was designed to collect information on the particular issue of Illegal, Unreported and Unregulated (IUU) fishing and the management strategies put in place to manage it as well as the analyses of the data obtained in the course of the survey in that regard. The following subsections contain the analysed results from the survey in terms of sources of IUU fishing, percentage and type that suffers from IUU fishing, organisations and parties involved in IUU fishing management, role of stakeholders in IUU fishing management, technology employed in managing IUU fishing, relationship between stakeholders' IUU fishing management strategies with other stakeholders', involvement of other people and organisations in IUU fishing management and stakeholders' opinions on how best IUU fishing can be curbed.

### **6.6.1 Sources of IUU fishing**

Analysis of the data obtained from the JDA revealed that participants are of the view that IUU fishing around the JDZ is being done by some EU and Asian countries. There were also cases of exceeding agreed limits by some EU countries based on their agreement with STP on the number and frequency of fishing boats allowable. This was further confirmed during the interview with the Chairman when he mentioned 'Ok.....we know that we have some illegal fishing activities going on.....ah.....ah.....the information we have sometimes.....is.....there are.....there are some illegal fishing boats that are operating that are from outside our region.....you know.....some countries from Asia and even some EU countries. For example, in Sao Tome & Principe when I was in government there; there is this agreement we had with some EU member states to allow certain number of fishing boats within our EEZ, but sometimes when you do some monitoring you find more boats than originally agreed, and these are from EU states, and these are based on reports from various agencies of government that provide some form of monitoring functions.....and initially we had some agreements with some EU states' parties who came round to tell us after about six months of coming into force of the agreement that they did not fish anything within our EEZ.....that is impossible you know.....when we know that their boats are

always there.....sometimes, when you take off from Sao Tome, you see all sorts of boats with clearly identifiable EU flags carrying fishing boats and everybody knows how rich that entire stretch of Gulf of Guinea is in terms of tuna fish and other species.....you know.....it is a bit complicated.....and I know that these countries you know.....that we have been discussing since like 2007 you know.....and we, together with the Gulf of Guinea Commission so that we bring some security, you know.....because when we have no security, you have all sorts of illegal activities prevailing.....you know.....the piracy.....all of these things you know.....is a big headache for the two countries you know.....'. However, other participants from the same JDA mentioned lack of adequate information on the IUU fishing to warrant disclosure, whereas others believe the IUU fishing report as far as the JDZ is concerned cannot be concluded due to insufficient and reliable data. Others also revealed that IUU fishing activities from the STP side is mainly by subsistent farmers incapable of causing a threat.

Participants from the NBC believe that only the technologically advanced countries can engage in IUU fishing due to the level and amount of technology involved, but felt short of naming or pinpointing any specific source due to lack of data while generally believing it to be from foreign vessels.

The viewpoint of participants from the Fisheries Department of Nigeria indicated that IUU fishing within and around Nigerian waters are mainly from vessels flying flags of convenience and other foreign vessels mostly from Japan, Korea and EU countries that usually target tuna. Whereas their STP counterparts collectively believed the IUU fishing activities are mainly from South Korea and EU.

The Nigerian Navy revealed that based on their arrests and available information, IUU fishing sources operating around Nigerian waters are from Spanish, Japanese, Chinese, and EU flagged vessels. While the Productivity Centre of the GCLME does not hold data for the exact JDZ location, it is of the opinion that IUU fishing activities around the Gulf of Guinea are generally from Asian and EU countries and this was known based on the remote sensing data obtained by the centre when used as a tool in combating IUU fishing within the GCLME countries.

Participants from the NIOMR however lamented the lack of documented data and uncooperative nature of the Nigerian Navy who make the arrests as impedance to knowing sources of IUU fishing. It is aware of un-reporting and underreporting of catches in addition to transshipment of illegal sales at sea but felt short of mentioning sources of IUU fishing due to lack of reliable data. The independent stakeholder equally believes the source to be from Asian and EU vessels.

A summary of the IUU fishing source as revealed by stakeholders from the survey is presented in Table 6.15:

Table 6.15: Summary of sources of IUU fishing around the JDZ as disclosed by stakeholders  
(Source: Author's own)

Stakeholders	Sources of IUU fishing
The JDA	European Union and Asian flagged vessels
NBC Nigeria	No particularly named source, believe from foreign vessels
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Japanese, Korean and EU-flagged vessels
Fisheries Department of the STP	South Korea and European flagged vessels
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Spanish, Japanese, Chinese and EU flagged vessels based on their arrests and available information
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Asian and EU vessels generally for the GCLME countries but unaware of exact source for JDZ specifically
NIOMR Nigeria	Unaware of source due to lack of credible data but aware of un-reporting and under-reporting in addition illegal sales at sea
Independent Stakeholder	Asian and EU-Flagged vessels

### **6.6.2 Percentage and type that suffers from IUU fishing**

There was a complete consensus among all participants from the JDA in both categories comprising of the executives and the mid-management cadre on the type of fishery that suffers from IUU fishing when all responded that it is mainly made up of tuna and shrimps. However, participants were quick to deplore the lack of a reliable data for calculating or knowing the percentage that suffers due to IUU fishing. This could further be confirmed when it was revealed that one of the foremost institutes of marine research in West Africa; NIOMR recognised the absence of a reliable data on IUU fishing as observed earlier in Section 6.6.1.

Data from almost all other participants apart from the fisheries departments of the two countries, including the NBC, Nigerian navy, NIOMR, the Productivity centre of the GCLME and the independent stakeholder revealed that IUU fishing actors mainly target large pelagic species such as tuna and tuna like in addition to shrimps. All of them equally could not give accurate percentage that suffers due to dearth of data and issues of reliability usually associated with the ones already held. Curiously, the two fisheries departments highlighted their inability to know type and percentage due to lack of credible data, requisite technologies and proper manpower and effective policing.

Disclosures of the types and status of percentage that suffers from IUU fishing by stakeholders are as presented in Table 6.16:

Table 6.16: Level of percentage and types of fish affected by IUU fishing  
(Source: Author's own)

Stakeholders	Percentage and types of fish that suffers from IUU fishing
The JDA	Mainly tuna, unknown percentage due to lack of data
NBC Nigeria	Mainly tuna and shrimps, unaware of exact percentage
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Unaware due to lack of manpower to police their waters
Fisheries Department of the STP	Unaware due to lack of requisite technologies to patrol
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	No data on actual percentage but aware that tuna and shrimps are mainly targeted based on their records of arrests and apprehensions
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Tuna and shrimps are mainly targeted based on remote sensing data for the GCLME but unaware of percentage
NIOMR Nigeria	Large pelagic species such as tuna and tuna-like but unaware of percentage due to lack of reliable data
Independent Stakeholder	Mainly tuna and shrimp fishery but unaware of percentage

### **6.6.3 Organisations and parties involved in IUU fishing management**

Analysis of the data from the JDA, fisheries department of Nigeria, independent stakeholder, the Nigerian Navy and NIOMR all revealed that the organisations and the parties involved in the downstream trading, management and handling of IUU fishing catches are the maritime securities agencies of the two nation States, NIMASA on Nigerian side, the Trawlers Owners Association and the perpetrators. Officials of all the mentioned agencies have been found to equally engage in encouraging or benefitting from the IUU fishing activity to the detriment of their host countries for their personal gains.

According to the Nigerian Navy, they do this in conjunction with some unscrupulous businessmen/women who connive with government personnel from agencies responsible for inspection and landing and a retinue of collaborators based on their records of apprehension.

Whereas other participants such as STP fisheries department and the NBC Nigeria and the Productivity centre of the GCLME are not aware of organisations and parties involved and in some instances declined to respond.

An overview of organisations and parties involvement based on stakeholders' revelation from the analysed data is as represented in Table 6.17:

Table 6.17: Overview of involvement with IUU fishing management revealed by stakeholders  
Source: (Author's own)

Stakeholders	Organisations and parties involved in IUU fishing management, downstream trading and IUU fishing catches
The JDA	NIMASA, Maritime Police and Trawlers Owners Association
NBC Nigeria	Unaware of managers, handlers and traders
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	NIMASA, the Navy, Maritime Police and conniving officials
Fisheries Department of the STP	Unaware of managers, handlers and traders
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Unscrupulous businessmen/women in connivance with government personnel from agencies responsible for inspection and landing and some collaborators
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Unaware of managers and handlers and the traders
NIOMR Nigeria	Marine Police, NIMASA, the Navy and Trawlers Association
Independent Stakeholder	NIMASA, marine Police and Trawlers Owners Association

#### **6.6.4 Stakeholders' role in IUU fishing management**

Data from the JDA revealed that participants believe the current stage of the JDZ fisheries does not encourage it to manage the IUU fishing of the JDZ directly as the main resource manager. They however mentioned that all they are doing now is initiating collaboration with the maritime security agencies of the two countries. They also revealed that the JDA through the JMC are presently working on establishing a joint security and policing outfit between the JDA and the maritime security agencies from the two countries for the protection and policing of the JDZ. This initiative is expected to put in place strong and permanent monitoring system and in conjunction with the current monitoring and inspection department of the JDA strengthen security of the fishing area thereby safeguarding the resources from poaching as well as boost investor confidence. This is because the collaboration is expected to bring about the establishment of a Joint Bilateral Military Commission (BMC); which will oversee the joint security and policing outfit.

The NBC's role in managing the IUU fishing has been found to be mainly advisory and provision of policy direction as a member of the JMC. It does these by provision of coordinates of potential fishing locations when needed; which can greatly help in establishing the regime.

Analysis of the data from the Fisheries Department of Nigeria revealed that the role it plays in IUU fishing management is creation of deterrence in its conduct within the Nigerian waters. It does this by licencing shrimping and fishing vessels and in monitoring the activities of the licenced fleets through its monitoring, control and surveillance department. However, it was also found that this important function is currently being impeded as a result of their inability to secure adequate manpower and equipment necessary for the discharge of its duties.

Similarly, the fisheries department of STP's data revealed that the role it plays in managing the IUU fishing within the STP waters is through reinforcement and collaboration on collective monitoring between State parties and sensitization with relevant authorities to create deterrence.

Whereas information from the Nigerian Navy revealed that the role of the navy as a military outfit is the protection of Nigeria's territorial and EEZ waters and checking documentation for compliance with relevant regulations. Another role is the apprehension of offenders, but this important role which has been very visible in recent times is threatened due to lack of functional and serviceable sea going vessels for consistent and dedicated patrol. Another challenge encountered by the navy obtained from the survey is the lack of clear legal framework that defines which country prosecutes, where, what and when in issues relating to the JDZ. This concern was further echoed when the two countries' sizes both in terms of landmass and population are factored into consideration in addition to their maritime security outfits; one has a functional full-fledged naval force while the other just boasts of a very small albeit ineffective coastguard unit.

The role being played by the Productivity centre of the GCLME when it was in operation was found to be the deployment of the use of satellite imagery of West African waters EEZs, where vessels engaged in IUU fishing could be accurately pinpointed and such images provided to interested parties on request.

On the other hand data from the NIOMR revealed that the institute has no role in managing IUU fishing around the JDZ as there is not in place a working relationship between them and the JDA yet and that the institute equally lack sufficient equipment and software necessary for tracking IUU fishing actors even within the Nigerian waters. The independent stakeholder revealed that the only role will be in awareness campaigns on the dangers of IUU fishing both to the economy and the health of the ecosystem either targeted at perceived practitioners or through periodic consultancy services being offered to organisation.

Summary of the roles of stakeholders in the IUU fishing management is as presented in Table 6.18:

Table 6.18: Summary of stakeholders' role in IUU fishing management  
(Source: Author's own)

Stakeholders	Roles in IUU fishing management
The JDA	Indirect role currently, collaboration with maritime security agencies on setting up permanent Joint security outfit for the JDZ
NBC Nigeria	Mainly advisory and provision of policy direction as a member of the JMC. Provision of coordinates for potential fishing locations
Boundary Commission of STP	Not known
Fisheries Department of Nigeria	Creation of deterrence through licencing and monitoring of shrimping and fishing vessels
Fisheries Department of the STP	Reinforcement and collaboration on monitoring between parties and sensitization to create deterrence
Ministry of Foreign Affairs Nigeria	Not known
Ministry of Foreign Affairs of STP	Not known
Nigerian Navy	Protection of Nigeria's territorial and EEZ waters and checking documentation for compliance with regulations
STP Navy (Coastguard)	Not known
Fish & Fishery Centre of the GCLME	Not known
Pollution & Ecosystem Health Centre, GCLME	Not known
Productivity Centre of the GCLME	Deployment of satellite imagery that accurately pinpoints vessels engaged for W. African EEZs
NIOMR Nigeria	No specific role and lacks requisite equipment
Independent Stakeholder	Awareness campaigns on its dangers through periodic consultancy services

### **6.6.5 Technology employed in managing IUU fishing**

There is currently no deployment of technology by the JDA to manage IUU fishing around the JDZ due to the current stage of the JDZ fishery. A detection system is being proposed by the JDA which shall be a satellite based and a response mechanism for the apprehension of offenders. This is in line with the assertion in Section 6.6.4 by the JDA on the efforts to establish a joint bilateral military commission as mentioned in the preceding section.

The technology employed by the NBC is in establishing and confirming coordinates using boat patrols and port state measures during maritime boundaries delineation exercises.

Data analysed from the Fisheries Department of Nigeria indicated that in 2013 it recently installed a Vessel Monitoring Service (VMS) in Lagos and Calabar, however revealed its inability to monitor effectively due to the relatively large size of the Nigeria's EEZ. They also revealed their reliance on information and intelligence exchange with relevant international and regional bodies such as NOAA's VOS and Ghanaian Navy among others. Similarly, the Fisheries Department of STP revealed the technology employed as an electronic monitoring system designed for monitoring and control and application of stringent sanctions when offenders are apprehended.

The only technology currently being employed by the Nigerian Navy as revealed from the analysis of the data is the electronic surveillance system mounted on the Regional Maritime Awareness Capability Centres (RMAC). It also admitted its limitations in range which may not be enough to cover all of Nigeria's EEZ.

Data from the Productivity centre of the GCLME indicated that the technology deployed by the centre when it was in operation for managing IUU fishing were sensors and transponders (mainly Aai transponders) for larger trawlers identification and synthetic aperture radar for the smaller trawlers identification.

The NIOMR does not deploy any technology in IUU fishing management due to the shortcomings mentioned earlier in Section 6.6.4, while the independent stakeholder does not respond to this part of the survey.

Types and status of technologies employed by stakeholders in managing IUU fishing are as visualised in Table 6.19:

Table 6.19: Positions of technology deployment by stakeholders to manage IUU fishing  
(Source: Author's own)

Stakeholders	Technologies deployed to manage IUU fishing
The JDA	None, but detection is being proposed
NBC Nigeria	Provision of coordinates using patrol boats
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Installed VMS in Lagos and Calabar
Fisheries Department of STP	Electronic Monitoring System for control
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	Electronic surveillance system on RMAC
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	Sensors and Aai Transponders
NIOMR, Nigeria	Does not deploy any due to lack of capacity
Independent Stakeholder	No response

### **6.6.6 Relationship between stakeholders' IUU fishing management strategies and other stakeholders' strategies**

Data obtained from the JDA executive participants revealed that the current stage of the JDZ fishery does not make relationship comparisons feasible but that each of the two countries has its individual regulations which they apply in terms of any illegal activity within its EEZ. Other participants equally hold similar views in addition to positing that potential JDA's IUU fishing management strategies will be in line with other Gulf of Guinea stakeholders' strategies. These positions are revealed because of the current stage of the fishery which is yet to be fully operational as earlier explained in Sections 6.3.4, 6.4.3, 6.4.4, 6.4.6, 6.5.1, 6.5.3, 6.6.1 and 6.6.4.

In the NBC of Nigeria, analysis of the data from participants indicated that their IUU fishing management strategies relate with other stakeholders' strategies in areas such as exchange of information, collaboration, joint analyses of data and in subscribing to the Nigerian fisheries policy as an agency of government.

The Fisheries Department of Nigeria's IUU fishing management strategies relate with others through collaboration with other Regional Fisheries Management Organisations (RFMOs) in areas of capacity building, institutional strengthening and stakeholder engagement in line with regional and international conventions and protocols. However, they reiterated that currently the department does not have any collaboration or cooperation with the JDA. The fisheries department of STP did not respond to this part of the survey.

It has been observed from the analysis of data from Nigerian Navy that there exists a fair collaboration between the Nigerian Navy's strategies with the STP's coastguard strategies on information sharing. However, this avenue for cooperation is not fully maintained due to STP's coastguard perception of inferiority in terms of its dealings with Nigeria.

As one of the five modules' centres, the Productivity Centre's strategy was in line with all the West African stakeholders' strategies. The NIOMR highlighted lack of sufficient equipment and even collaboration with the JDA for it to formulate its own

strategy. As such it presently lacks the capacity to develop strategies for mitigating IUU fishing. An area of relationships with other stakeholders' strategies as revealed by independent stakeholder is in creating awareness capable of deterring potential practitioners.

Summary of individual stakeholders' relationships with others are as detailed in Table 6.20:

Table 6.20: Relationship of stakeholders' strategies with others in IUU fishing management (Source: Author's own)

Stakeholders	Relationship with other IUU fishing management strategies
The JDA	Too early to make relationships comparison feasible
NBC Nigeria	Information exchange, collaboration and joint analyses
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Collaboration with RFMOs in capacity building, engagement
Fisheries Department of STP	Declined response
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	Fair collaboration with STP coastguard amid suspicions
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	Relates with all GCLME countries as a R.A.C. of the project
NIOMR, Nigeria	Highlighted inadequate capacity to develop strategy
Independent Stakeholder	Creation of awareness through sensitization campaigns

### **6.6.7 Stakeholders' opinions on how best IUU fishing can be curbed**

Analysis of the data obtained from the JDA participants revealed varied opinions on how best IUU fishing challenges can be addressed. The majority were of the opinion that for IUU fishing to be reduced or curbed there is the need for cooperation between the naval authorities of Nigeria and all the West African countries. This is on the premise that IUU fishing activities around the JDZ affects the entire stretch of the Gulf of Guinea and as such collaboration between and among the GCLME countries is necessary if it is to be curbed successfully. Others opined that there is need for constant monitoring and inspection within the JDZ, combined use of satellite technology, response boats and stringent fines to create deterrence.

Participants' data from the NBC revealed opinions on the most appropriate way for combating IUU fishing to comprise of conduct of a comprehensive survey to determine source, type and percentage, movement patterns, seasonal patterns and updating of available technologies to meet the current standards. Other ways mentioned are training, education and sufficient funding for equipment in addition to deployment of satellite based tracking technology.

Executive participants from the fisheries department of Nigeria are of the opinion that for IUU fishing to be curbed there should be in place a functional and serviceable VMS, adequate funding of the monitoring, control and surveillance department and institutionalisation of greater cooperation and collaboration between and among regional agencies of governments so that each becomes aware of what the other is doing. Other mid-management level participants were of the opinion that there should be active participation of all relevant maritime security agencies in addition to installation of state of the art monitoring and surveillance equipment. This shall be followed by a well-funded and effective coastguard service, capacity building and introduction of observer programme.

The Fisheries Department of STP are of the view that the best way to curb IUU fishing around the JDZ is when the JDA make their mitigation strategies in line with the two countries' IUU fishing mitigation strategies.

Similarly, information derived from the analysis of the Nigerian Navy's data revealed that for the IUU fishing to be effectively curbed, there should be a strong synergy among all the stakeholders in terms of funding from the resource managers (the JDA) to lure other stakeholders for the acquisition of equipment that can be able to serve as dedicated patrol and enforcement equipment (Borit & Olsen, 2012; Polacheck, 2012). Other ways suggested are use of improved surveillance and deployment of response and satellite technologies for the entire Gulf of Guinea.

Information for the Productivity centre of the GCLME revealed that while it was in operation it employed the combination of satellite based tracking technologies and strong sanctions capable of deterring offenders because IUU fishing was found to be a huge concern for the Gulf of Guinea countries. This was buttressed by the revelation from the former coordinator of the centre that despite not being in operation; he is aware that some GCLME countries through the FCWC are in the process of reporting some powerful erring IUU fishing practitioners to international regulatory bodies such as the UN. This was re-echoed when he mentioned '..... there are attempts now to report some erring practitioners to international regulatory bodies like the UN through the FCWC even though the GCLME project as a whole as mentioned earlier has folded up since 2010'.

The NIOMR participants are of the opinion that for IUU fishing to be curbed, there should be consistent monitoring and sensitization of those involved, improved coordination between and among relevant governmental agencies responsible for fisheries management and those responsible for maritime security. They further revealed that an Inter-agency Maritime Operation Coordination Committee (IMOCC) was recently formed but that they were yet to be formally informed about its composition and operation.

Independent stakeholder's opinion on the best way to curb IUU fishing was the deployment of satellite based technology and strong inter-governmental cooperation among the GCLME countries.

Table 6.21 provides a summary of the stakeholders' opinions as revealed from the survey:

Table 6.21: Summary of stakeholders' opinions on bet ways to curb IUU fishing (Source: Author's own)

Stakeholders	Opinions on the best ways of curbing IUU fishing
The JDA	Cooperation between all naval authorities of the West African sub-region, monitoring & inspection, response boats and satellite technology
NBC Nigeria	Comprehensive survey to determine source, type, percentage, movement and seasonal patterns of the species and update of existing technologies
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Provision of functional VMS, adequate funding of its MCS dept., establishment of a coastguard, capacity building and introduction of observer programme
Fisheries Department of STP	JDA to align its mitigation strategies in line with the two countries' mitigation strategies
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	Strong synergy between the JDA and all stakeholders followed by a robust funding to lure other stakeholders to invest in equipment
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	Combination of satellite based technology and strong sanctions capable of creating deterrence
NIOMR, Nigeria	Consistent monitoring and sensitization on those engaged in the act and improved coordination and collaboration between agencies involved in fisheries management in all the GCLME countries
Independent Stakeholder	Deployment of satellite based tracking technology and strengthening inter-governmental cooperation between and among the entire Gulf of Guinea States

## 6.7 Level of awareness/employment of indicators

This section of the survey was designed to collect information on the use, knowledge and employment of indicators for the assessment and management of the sustainability of marine fisheries within the JDZ. The following subsections contain the analysed results from the survey in terms of existence of sustainability agenda such as Agenda 21, existence of indicator-based sustainability assessment, types of indicators employed for sustainability assessments, measures taken by stakeholder organisations to ensure indicator based sustainability assessments and

stakeholders liaison with others to develop indicator based sustainability assessments.

### **6.7.1 Existence of sustainability agenda such Agenda 21**

Analysis of the data from the JDA executive participants revealed that while there may not be in place a formal and deliberate agenda for ensuring sustainability assessments currently, the sustainability of the JDZ fisheries is intended to be achieved through the issuance of preferential licences to local and internationally reputable entrepreneurs from the two nations among other techniques. They also added that the whole concept of establishing the JDZ is based on fulfilling the objectives and provisions of chapter 17 of Agenda 21 of the UN. Other participants' data also revealed that rigorous review of the environmental conditions and the impact of climate change studies can be used to measure or gauge sustainability, while two participants were not aware of the existence of such an agenda and what it was intended to achieve.

Participants from the NBC believed that such an agenda exists but lamented the lack of desire and zeal to implement it when related to other stakeholders' responses.

Results from the Fisheries Department of Nigeria executive participants indicated that a sustainability agenda exists and that the implementation of the VMS installations was as a result of compliance with the provisions of the agenda- Nigeria being a signatory to the United Nations Conference on Environment and Development (Umar, 2002; Oduntan, 2008; Uche-Okeke, 2008). Other participants however from the mid management cadre are not aware of the existence of such an agenda or simply do not know what it stands for. Whereas the fisheries department of the STP participants are aware of the existence of sustainability agenda such as Agenda 21 as an initiative of the UN, but they are not sure of its existence for the JDZ fisheries.

The Nigerian Navy as an institution was not aware of the existence of any sustainability agenda for the JDZ fisheries but revealed general awareness of Agenda 21 sustainability for Nigerian waters since the country is a signatory to the

1992 UNCED conference and UNCLOS. This view was similarly expressed by the participants from the NIOMR; who were equally unaware of its existence specifically for the JDZ fisheries.

Data obtained from the Productivity Centre of the GCLME revealed that the whole GCLME project was initiated in line with the provision of and desire to implement the Agenda 21 objectives. However, whether or not the JDZ fisheries subscribes to it or not depends on the policy direction of the JDZ fisheries managers but it was revealed that since the JDZ is within the larger GCLME, it is most likely that the managers also regard it as a concept for the common benefit of ensuring sustainability.

The independent stakeholder's data revealed that since Agenda 21 is accommodated by almost all the West African and other RFMOs, it is almost likely it is being considered for the management of the JDZ fisheries resources.

Table 6.22 is a summary of stakeholders' responses on the existence of a sustainability agenda such as Agenda 21 for the JDZ fisheries from their organisations' viewpoints.

Table 6.22: Summary of responses on the existence of sustainability agenda for JDZ fisheries  
(Source: Author's own)

Stakeholders	Existence of sustainability agenda such as Agenda 21 for the JDZ fisheries
The JDA	The whole concept of establishing the JDZ is in response to Agenda 21 objectives
NBC Nigeria	Exists but lamented lack of desire and zeal to implement across relevant stakeholders
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Exists for Nigerian marine waters as a signatory to the UNCED and the installation of the VMS is as a result of fulfilment of its objectives
Fisheries Department of STP	Aware of existence of Agenda 21, but unaware how or if it is implemented for JDZ fisheries
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	Aware of existence of Agenda 21 for Nigerian waters as a signatory to UNCLOS but unaware of how it is implemented for the JDZ fisheries
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	The whole GCLME project was due to the desire to implement the Agenda 21 objectives
NIOMR, Nigeria	Aware of existence of Agenda 21 for Nigerian waters as a signatory to UNCLOS but unaware of how it is implemented for the JDZ fisheries
Independent Stakeholder	Aware of its existence since all the Gulf of Guinea countries are signatories to the UNCED

### **6.7.2 Existence of indicator-based sustainability assessments**

Results from the JDA participants revealed that currently indicator-based sustainability assessment for the JDZ fisheries is not employed. This is because the fishery regime is yet to fully commence to warrant such an assessment. Another interesting revelation was that almost all the respondents are not aware of the need for initiating an indicator-based assessment. This was further confirmed by the details of the preliminary surveys they commissioned recently which did not take into account an indicator based assessment direction. This is in spite of the persistent global call for that in advancing fisheries management initiatives by international agencies and academia.

Similarly, participants from the NBC believed it has not been previously tried for the JDZ fisheries but that it may be incorporated in future assessments.

The Fisheries Department of Nigeria participants are also unaware of indicator-based sustainability assessments for the JDZ fisheries and interestingly even for the Nigerian waters except in the monitoring of fish landings. This is despite being under their jurisdiction. They equally revealed no other indicator has been tried or tested by their organisation. This was also true for their STP counterpart who revealed exactly the same position.

The Nigerian Navy also as an institution is not aware of the existence of any indicator-based sustainability assessment either for Nigerian waters as a whole or for the JDZ fisheries specifically.

However, data from the Productivity centre of the GCLME revealed that several indicators have been employed for the entirety of the Gulf of Guinea as the GCLME project was initiated with the sole aim of testing and developing the five modules of LME indicators for the West African countries.

The participants from the NIOMR are aware of the existence of the five modules of LME indicators for assessing the sustainability of the GCLME region but lamented inability to ensure full implementation in the face of the closure of the whole project including its Regional Activity Centres (RACs).

The independent stakeholder’s data equally revealed in relationship with other stakeholders, the existence of the LME indicators for the Gulf of Guinea but equally deplored the inability to sustain the project which led to its suspension.

A summary of the existence of an indicator-based sustainability assessment for the JDZ fisheries based on stakeholders’ responses is presented in Table 6.23:

Table 6.23: Summary of responses on existence of indicator-based sustainability assessment (Source: Author’s own)

Stakeholders	Existence of indicator-based sustainability assessment for the JDZ fisheries
The JDA	There is currently no indicator-based sustainability assessment for the JDZ
NBC Nigeria	There has not been any indicator-based sustainability assessment previously tried
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Unaware of any indicator-based sustainability assessment for the JDZ and the Nigerian waters
Fisheries Department of STP	Unaware of any indicator based sustainability assessment for the JDZ and the STP waters
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	Unaware of the existence of any indicator-based sustainability assessment for the JDZ
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	Aware of several including the five LME indicators that was designed to assess the entire Gulf of Guinea under the GCLME project
NIOMR, Nigeria	Aware of the LME indicators for the GCLME but lamented inability of the project to implement
Independent Stakeholder	Aware of the existence of initiative under the GCLME to assess sustainability using the five modular suites of indicators but lamented inability of the project to implement

### 6.7.3 Types of indicators employed for sustainability assessments

Data from executive participants from the JDA revealed that since there are no indicator-based assessments in place yet as a result of the current stage of the JDZ fishery regime, it is inconceivable to have or know the types of indicators for sustainability assessments of the JDZ fisheries. Other non-executive participants however revealed that proposed indicators such as the identification of spawning areas, climatic conditions, and human activities in and around the JDZ should be used for the JDZ fisheries sustainability assessments when the need arises.

Results obtained from the NBC data indicated that it does not use indicators to manage any resource of the JDZ except in the periodic reports of abundance and catches usually obtained in the course of maritime boundaries delineation exercises (NBC et al., 2009).

Participants from the Fisheries Department of Nigeria revealed that they are not aware of any indicator being used or employed for the JDZ fisheries assessments, but that the VMS used for monitoring fish landings is the only indicator known to the fisheries department of Nigeria and currently in use. The Fisheries Department of the STP on the other hand are not aware of any type of indicator based on the analysis of relationships for the data obtained from the two similar agencies.

While the Navy is not aware of or use any indicator for the JDZ fisheries, it uses its own standard operating procedure for the protection and security of Nigeria's territorial waters and EEZ to measure the success or otherwise of its operations.

The types of indicators earmarked for the GCLME sustainability assessment as revealed by the Productivity centre participants from the data are the five modular suites of indicators of productivity, fish and fisheries, pollution and ecosystems health, socioeconomics and governance.

The NIOMR uses biomass, Maximum Sustainable Yield (MSY) and size variation in conducting its own stocks assessments for the Nigerian waters, but do not know or use any for the JDZ fisheries.

Independent participant on the other hand lamented lack of requisite collaboration between the JDA and relevant stakeholders to warrant having or even knowing such and their types.

Overview and status of the types of indicators employed for sustainability assessments by stakeholders is as presented in Table 6.24:

Table 6.24: Overview of indicators deployed for JDZ fisheries revealed by stakeholders (Source: Author's own)

Stakeholders	Types of indicators employed for sustainability assessments
The JDA	Inconceivable to identify types at this stage of the JDZ fishery, suggests identification of spawning areas, climatic condition and human activities as potential candidate indicators
NBC Nigeria	Does not use indicators but periodically reports on abundance and catches obtained from data during delineation of maritime boundary exercises
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Uses VMS for monitoring fish landings within Nigerian waters but does not employ any for JDZ assessment
Fisheries Department of STP	Unaware of any for the JDZ and the STP waters
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	Uses its own standard operating procedure for the protection and security of Nigerian waters; does not know any for the JDZ assessment
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	Five LME indicators of Productivity, Fish & fishery, Pollution & Ecosystems health, Socioeconomics and Governance
NIOMR, Nigeria	Biomass, MSY and Size variation for Nigerian waters but does not know or employ any for JDZ assessments
Independent Stakeholder	Unaware due to lack of requisite collaboration and cooperation between and among relevant stakeholders

#### **6.7.4 Measures taken by organisations to ensure indicator-based sustainability assessment**

Analysis of the data from the JDA participants revealed that among the measures so far taken to ensure indicator-based assessment is that the JDA commissioned a survey to guide it on the nature of the JDZ fisheries. This is to enable it establish a baseline data upon which they can be able to develop indicators and subsequently conduct an indicator-based sustainability assessment.

It has been deduced from the data that there are no measures taken by the NBC to ensure indicator-based sustainability assessment except in the provision of periodic and annual reports concerning the state of the maritime boundaries of Nigeria.

The Fisheries Department of Nigeria's analysed results revealed that among the measures taken by the department to ensure indicator-based sustainability assessment are the issuance of licences, deployment of its VMS, monitoring, control and surveillance in addition to collaboration with regional and international institutions for the Nigeria's marine waters including its EEZ. This extends to a part of the JDZ not the whole as it transcends the Nigeria's EEZ; being an area of two countries' overlapping EEZs. The Fisheries Department of the STP on the other hand indicated that they can contribute towards ensuring an indicator-based sustainability assessment for the JDZ only when they are invited to participate and are not willing to divulge on the current measures put in place by them towards ensuring that.

The Nigerian Navy does not have any contribution or measures in place to ensure an indicator-based sustainability assessment currently based on the analysis of the data.

Among the measures put in place by the Productivity Centre of the GCLME to ensure indicator-based sustainability assessment during the life cycle of the project was cooperating with the UN division of early warning system as well as starting a partnership with IOC-UNESCO who spearheaded the project and it was funded by the GEF (IOC-UNESCO, 2011; Pernetta & Bewers, 2012).

It was revealed from the NIOMR data that the institute has not put in place any measure to ensure an indicator based sustainability assessment for the JDZ, but does have a system in place for the Nigerian waters through consistently updating the indicators it employs as explained in Section 6.7.3 above.

The independent stakeholder's contribution from the analysed data revealed engagement through the training of the GCLME personnel on the use of Ecopath with Ecosim (EwE) software for ecological, social and economic analysis of fisheries for the Gulf of Guinea assessments under the GCLME project.

Measures put in place by stakeholders to ensure indicator-based sustainability assessments are as summarised in Table 6.25:

Table 6.25: Overview of measures taken by stakeholders to ensure indicator-based assessments (Source: Author's own)

Stakeholders	Measures taken by organisations to ensure indicator-based sustainability assessments
The JDA	Commissioned a preliminary survey to establish baseline data that may help in developing indicators
NBC Nigeria	No specific measures except in the provision of periodic and annual reports on status of maritime boundaries of Nigeria
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Licencing, VMS deployment, monitoring, control and surveillance and collaboration with RFMOs
Fisheries Department of STP	Currently none, willing to contribute on invitation by the JDA
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	No any measure in place known
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	Collaboration with UN division of early warning system and cooperation with IOC-UNESCO
NIOMR, Nigeria	No measure for the JDZ, but consistently updates its indicators for Nigerian waters, namely; Biomass, MSY and Size variation
Independent Stakeholder	Trained GCLME personnel on the use of Ecopath with Ecosim (EwE) software for socioeconomic and ecological analyses of fisheries

### **6.7.5 Stakeholders' liaison with others to develop indicator-based sustainability assessment**

Results from the analysis of the JDA participants' data revealed that there is ongoing collaboration with the FAO and the Norwegian Institute of Marine Research. The Institute was found to be very supportive of the JDA's efforts in the recent survey conducted which is expected to help towards developing indicator-based assessments. They also revealed having some unsuccessful attempts to foster liaison with EU countries and Russia.

The NBC on its part envisaged the formulation of liaisons through its participation as a member of the JMC where it will always make its contacts and network available for the success of the JDA in developing an indicator-based sustainability assessment.

The Fisheries Department of Nigeria revealed that it is in liaison with the ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic (COMHAFAT/ATLAFCO), the Fisheries Committee of the West and Central Gulf of Guinea (FCWC), the Food and Agricultural Organisation (FAO) and the EAF-Nansen projects to develop indicator-based sustainability assessment.

Similarly, the Fisheries Department of the STP revealed that they are not in liaison with any other stakeholder to develop any indicator-based sustainability assessment. However, they were quick to add that it is very important to develop indicators suitable to the JDZ based on its uniqueness for measuring and tracking resource sustainability.

While the Nigerian Navy does not directly engage in managing the JDZ fisheries resources, it was revealed that it is in liaison with other agencies of government such as NIOMR, NIMASA and the Fisheries Department of Nigeria. However, it also regretted the absence of such a liaison with the JDA currently in terms of the JDZ resources.

Data analysed from the Productivity centre of the GCLME revealed that at the beginning, the project collaborated with the National Oceanic and Atmospheric

Administration (NOAA) and the University of British Columbia (UBC) Sea around Us project. It then served as the regional coordinating unit of the GCLME responsible for implementation of productivity plans and involvement of other stakeholders afterwards.

Data from the NIOMR revealed that as a research institute, it has been cooperating with all the 16 countries of the GCLME since the advent of the GEF-LME project for the entire Gulf of Guinea but not for just JDZ specifically.

The independent stakeholder's liaison efforts were found to be through consulting for projects such as the GCLME as identified in Section 6.7.4 as well as in promoting partnerships among stakeholders through sensitization campaigns.

An overview of stakeholders' efforts towards liaison with others to develop an indicator-based sustainability assessment is as presented in Table 6.26:

Table 6.26: Overview of stakeholders' liaison with others to develop indicators (Source: Author's own)

Stakeholders	Liaison with others to develop indicator-based sustainability assessments
The JDA	Liaised with FAO, Norwegian Institute of marine Research
NBC Nigeria	Envisages such, but only does as a member of the JMC and willing to avail the JDA of its network
Boundary Commission of STP	Unknown
Fisheries Department of Nigeria	Collaborates with COMHAFAT/ATLAFCO, FAO, FCWC and EAF-Nansen projects
Fisheries Department of STP	Currently not in liaison to develop any for the JDZ and the STP but recognised its importance
Ministry of Foreign Affairs, Nigeria	Unknown
Ministry of Foreign Affairs, STP	Unknown
Nigerian Navy	No direct engagement, but maintains regular liaison with critical partners/agencies
STP Coastguard	Unknown
Fish & Fishery Centre, GCLME	Unknown
Pollution & Ecosystem Health, GCLME	Unknown
Productivity Centre, GCLME	NOAA and UBC Sea Around Us Project
NIOMR, Nigeria	Liaises with the 16 countries of the GCLME but no for JDZ specifically or any other unit
Independent Stakeholder	Collaborates with firms and other RMFOs through offering consultancy services as an expert

## 6.8 Summary

Data from the surveys revealed that the JDA is the only constitutionally recognised body set up to manage the overall resources of the JDZ. It is also the main regulator of all the affairs that take place within the JDZ including all aspects of monitoring, licencing and governance pursuant to Article 8 of the JDZ treaty. There are however some variations from across other stakeholders in terms of their organisational roles, involvement with the JDZ fisheries management, how their organisations fit and how the JDZ fisheries resources are monitored.

Data from the surveys revealed that a variety of convergence and divergence of policy adoptions by stakeholders who sometimes concur and differ in their approaches respectively as far as the JDZ fisheries resources are concerned.

Data from the surveys also revealed that there is currently no regime in existence for the JDZ fisheries but plans are underway towards establishing one. This is equally in addition to absence of a licence system but steps have been found to be taken towards establishing one as well. A variety of stakeholders that should be involved were equally revealed by stakeholders during the course of the survey.

Data from the surveys further revealed a significant extent of IUU fishing prevalence around the research area with majority of the revelation pointing to the EU and Asian nations as main sources (Bray, 2000; Sumaila, Alder & Keith, 2006; Falaye, 2008). While participants differed on percentage of fisheries that suffers from IUU fishing, there was near consensus on the need for deployment of modern technologies and stiffer sanctions to curb it and create deterrence (Trouillet et al., 2011; Polacheck, 2012).

Data also revealed that there is inadequate awareness of the use and employment of indicators from across the broad spectrum of stakeholders and that the main resource managers (the JDA) indicated insufficient efforts towards adopting indicator-based sustainability assessment. This is in spite of over a decade of the JDZ operations and the persistent call for indicator-based sustainability assessments by regional and international agencies such as the UN and other RFMOs.

### 6.8.1 Key observations

- Results from the analyses revealed that the JDA does not have a substantive fishery management regime in place at the moment due to lack of attention to marine living resources as a result of inclined interest on hydrocarbons resources even as the treaty explicitly covered marine living resources. It is hoped however, that recommendations and lessons to be learnt from the analysis would contribute towards strengthening the fishery regime since it is in the stage of being developed.
- The fishery management regime of the JDZ as revealed from the analysed data is currently at the stage of being developed as all efforts have been largely devoted to hydrocarbons resources exploration since the establishment of the JDA thereby neglecting the living resources. This was further confirmed during the interview with the chairman of the JDA and one of the directors and concurred by several other stakeholders.
- There is a clear lack of integration, synergy and general awareness between and among the general stakeholders as far as the activities of the JDZ are concerned. A key element for sustainable marine resource management among the stakeholders.

Chapter Seven will evaluate the analysed survey results against ideal indicator requirements so as to assess the extent of compliance within the JDZ fishery management arrangements. This is to enable more explicit identification of where and in what form the current JDZ fishery management arrangements are sub-optimal or currently lacking.

## **Chapter Seven: Evaluation of indicator performance against other models**

### **7.1 Introduction**

This chapter will evaluate the analysed survey results from the preceding chapter against ideal indicator requirements so as to assess the extent of compliance within the JDZ fishery management arrangements with a view to identifying more explicitly where and in what form the current JDZ fishery management arrangements are sub-optimal or currently lacking.

It will further identify from the preceding literature and international best practices as well as examples in practice alternative ways forward for the main resource managers (the JDA) to address these areas, and evaluate those alternatives against ideal indicators' requirements and the institutional frameworks and challenges in the case study area.

This will be followed by identifying a logical and practical sequencing of steps towards establishing an appropriate system of fisheries management for the JDZ fisheries (manifest by performance against the indicators).

Outcomes from the evaluations will then be passed on to the JDA management for their feedback and comments which will then be integrated into the PhD so as to draw conclusions and recommendations capable of being adopted by the JDA for sustainable JDZ fisheries management as well as being replicable elsewhere.

### **7.2 Current levels of the JDZ fisheries management**

The current stage of the JDZ fisheries management indicated that there exists no subsisting fisheries management regime by the JDA. A variety of policy adoptions by identified stakeholders who sometimes converge and diverge with the resource managers have been revealed and reported. Overviews of the sectional levels for the themes adopted for the survey to reveal the current level of the JDZ fisheries are hereby presented in Sections 7.2.1 to 7.2.5.

### 7.2.1 The management structure

Results from the analysis of the role of the stakeholders revealed that while the JDA is statutorily, constitutionally and legally recognised as the main body responsible for the JDZ marine fishery resources management; varying levels of participation by the identified stakeholders have been identified depicting their individual statutory functions in addition to lack of collaboration and coordination as reported in Section 6.3.1. These synergies need to be established between and among stakeholders for a sustainable fishery management regime to be successful. This is because the concept, process and principle of sustainability are underpinned by clear roles and responsibilities often achieved through institutional reforms (Potts, 2006). It has also been established (Potts, 2006) as the case rather than the exception in fisheries indicator systems that often when the objectives component of the indicator is established, the evaluation mechanism is neglected leading to uneven adoption and subsequently implementation across a range of jurisdictions (Sainsbury & Sumaila, 2001; Hillborn, 2002).

The diversity of roles played by the various stakeholders as identified in Table 6.0 of Section 6.3.1 further confirmed the absence of proper coordination between and among the stakeholders and equally justified the need for an institutional reform for achieving sustainability in the JDZ fishery management (WCED, 1987; Charles, 1997; Sainsbury & Sumaila, 2001; Ward et al., 2002).

Results from the analysis of stakeholders' fitness (suitability) in the JDZ fisheries management revealed that although the JDA is the body assigned the responsibility to manage all the resources of the JDZ, most of the other stakeholders are unsure or unspecific where they fit into the JDZ fishery resources management. Few others depicted indirect fitness into the management due to lack of cooperation and coordination between and among the identified stakeholders as shown in table 6.1 of Section 6.3.2 and as required for marine fishery sustainability as attested by a number of scholars (Sainsbury & Sumaila, 2001; Hillborn, 2002; Ward, 2002; Rice & Rochet, 2005; Potts, 2006).

Analysis of the data on stakeholders' involvement with their various organisations revealed varying degrees of involvement ranging from four to over forty years as shown in Table 6.2 of Section 6.3.3 representing different strata of human resource cadre across a broad range of stakeholders; with the executive members having the most number of years of engagement with their organisations. This may be very useful in terms of consolidating policy decisions (Sutinen et al., 2000) and in ensuring continuity so that initiatives such as indicators design, development and deployment can be successful and sustained (Buuren et al., 2002; Ehler, 2003; Rice & Rochet, 2005; Potts, 2006; Powers & Monk, 2010).

On the monitoring of the JDZ fisheries resources, the analysis of the data revealed that while the JDA as the main resource managers currently provides only partial monitoring of the JDZ through its M & I and NHR departments, almost all the other stakeholders provide indirect monitoring apart from the Nigerian Navy, which was found to be engaged in direct monitoring of Nigeria's sector of the JDZ via its routine patrol system as indicated in Table 6.3 of Section 6.3.4. These fragmentations negate one of the basic expectations of marine ecosystem resource management initiatives which require the linking of a network of institutions (Hennessey, 1997) in order to deal with monitoring an ecosystem's complexity for the achievement of optimal benefits (Creed & McCay, 1996; Sutinen et al., 2000).

Another very important issue that came to the fore in terms of monitoring is the issue of jurisdiction because the JDZ cuts across the two countries' jurisdiction and it is difficult to identify where one country's jurisdiction ends and the other's starts. This is because identifying governance mechanisms is a matter that needs to be explicitly dealt with (Sutinen et al., 2000; Juda & Hennessey, 2001) more so with the absence of an established monitoring system in place by the JDA which has the statutory control over the JDZ so as to ensure monitoring system is in place for an effective governance profile.

Analysis of the direct involvement with JDZ fisheries by identified stakeholders revealed that the NHR department of the JDA is the one with direct involvement. While for other stakeholders, the departments that relates to each of the country's

territorial waters and beyond as depicted in Table 6.4 of Section 6.3.5 differ across the range of stakeholders depending on the stakeholder and its statutory functions. This also brought to the fore the issue of cross-boundary jurisdiction between and among the range of identified stakeholders.

A summary of the issues observed as it relates to the JDZ fisheries management structure between and among the identified stakeholders from the survey is presented in Table 7.0.

Table 7.0: Situation of the JDZ fisheries management structure  
(Source: Author’s own)

<b>Management Structure</b>
<ul style="list-style-type: none"> <li>• Inadequate and inappropriate institutional framework</li> <li>• Lack of coordination and collaboration among identified stakeholders</li> <li>• Uneven distribution of management intervention initiatives among identified stakeholders</li> <li>• Inability of majority of stakeholders to determine fitness into the JDZ fisheries management structure</li> <li>• Evidence of substantial/prolonged engagement by most of the personnel</li> <li>• Evidence of uncoordinated monitoring across range of stakeholders raising concerns over issues of jurisdiction</li> <li>• Evidence of varied involvement with the JDZ fisheries</li> </ul>

### **7.2.2 Management policies adopted for JDZ fisheries**

Analysis of the JDZ stakeholders’ fisheries policies by the JDA indicated that conceptualisation and design of policies were based on the need to develop alternative sources of revenue as reported in Section 6.4.1. This is in addition to ensure compliance with existing treaties, statutes and conventions as opposed to the maintenance of ecosystem health as expected of ecosystem-based management practices (Wang, 2004; Gaichas, 2008). However, the need to view marine environmental ecosystems from the point of view of the three-dimensional concepts of irrelevance of administrative boundaries, transboundary nature of the resources and complexity of marine ecosystems interactions; which is primarily to

maintain its health (Smith, 1991; Couper, 1992. Smith, 1992) cannot be over-emphasised. As such, for sustainability to be achieved, the marine environment must be viewed holistically.

This may have been one of the reasons why the GEF strongly advocated integrated ecosystem based management as a very important (Wang, 2004) and useful system of managing marine environmental resources (Sherman & Duda, 1999; Vallega, 1999; Garcia & Cochrane, 2005; Sherman et al., 2009; Aanesen, Armstrong & Hoof, 2012).

The objectives of the JDA's fisheries policies as revealed from the analysis in Section 6.4.2 from across the varying stakeholders' responses include determination of abundance, distribution, availability awareness, revenue generation, sustainable exploration and exploitation in addition to ensuring the sustainability of the resources as well as guaranteeing the health of the ecosystem. This could be said to be in line with principles of ecosystem based management practices (Wang, 2004; Garcia & Cochrane, 2005; UNEP, 2007). However, it is one thing to set out sound and clear objectives and another to ensure they are adequately followed. The current position of the JDZ fisheries development as highlighted in several sections of this thesis (Sections 6.4.1, 6.5.1 and 6.5.3) does not make the valuation of the objectives feasible due to the current stage the JDZ fisheries.

Analysis of the data on processes and procedures for the JDZ policy adoptions revealed that while the JDA is yet to have a fully functional JDZ fishery regime in place due to the reasons adduced to variously in this and previous chapters, there are in place processes and procedures it followed and is still following in terms of adopting its JDZ fisheries policies. These include tapping from the STP experience being an archipelagic State, engagement of independent experts, conduct of surveys for the determination of flora, fauna and species abundance in addition to engagement and harmonisation of individual State parties' fisheries policies in line with the need for the articulation of sustainability concerns in marine fisheries (Potts, 2006; Beliaeff & Pelletier, 2011).

This also concurred with other stakeholders' assertions in terms of policy processes and procedures as highlighted in Table 6.7 in Section 6.4.3.

Results from the analysis of convergence and divergence of the JDA's fisheries policies with other identified stakeholders indicated that while it may be premature to explicitly identify points of convergence or divergence at this stage of the JDZ fisheries. It is envisaged that there would be more of convergence than divergence with most stakeholders save for some few such as the Nigerian Navy, who identified areas of divergence with some stakeholders such as the Nigeria Trawlers Owners Association for their unwillingness to share information.

Convergence of policies however has been identified as an important recipe for selecting (Rice & Rochet, 2005) and constructing indicators (Beliaeff & Pelletier, 2011).

Other stakeholders such as the NBC, the Fisheries Department of Nigeria and most importantly the JDA projected strong convergence of policies with all other stakeholders when the fishery regime is fully developed in line with the common goal of sustainability and maintenance of ecosystem's health as depicted in Table 6.8 of Section 6.4.4.

Furthermore, findings from the data on the most effective areas of organisation from the JDA highlighted the conduct of the preliminary marine survey and attraction of potential investors during the presentation of their report as one area they were most effective at. This is in line with design and development of sustainability indicators (Rice & Rochet, 2005; Potts, 2006; Beliaeff & Pelletier, 2011).

This is in addition to establishing territoriality and delimitation of the JDZ (Rice & Rochet, 2005; Potts, 2006) by the NBC as well as developing access control, issuance of licences, enforcement of fishing gear control and conservation of endangered species by deployment of turtle excluder devices (Beliaeff & Pelletier, 2011) by the fisheries department of Nigeria.

Others include fostering collaboration and cooperation between and among GCLME countries by the Productivity centre as well as enactment of legislations such as the Sea Fisheries Act by the NIOMR as detailed in Section 6.4.5 and Table 6.9 of the same section.

The inability, to provide adequate security to deter IUU fishing, attract credible investors so far and commence fisheries economic activities after over a decade of operation was revealed by the JDA to be among some of the areas where they are most ineffective. While the fisheries department of Nigeria and their STP counterpart identified inability, to establish VMS, fishing patrol vessels, curb sea piracy, robbery, tuna exploitation, IUU fishing and lack of expertise in managing deep sea resources as some of the areas they are most ineffective at as highlighted in Table 6.10 of Section 6.4.6.

These deficiencies have been identified as some of the issues that must be tackled for establishing indicator-based marine fishery sustainability assessments (Rice & Rochet, 2005; Potts, 2006; Gaichas, 2008; Beliaeff & Pelletier, 2011).

An overview of the management policies adopted for the JDZ fisheries based on the analysed results from the survey is summarised in Table 7.1.

Table 7.1: Overview of the JDZ fisheries management policies  
(Source: Author’s own)

<b>Management Policies adopted for JDZ Fisheries</b>
<ul style="list-style-type: none"> <li>• To develop alternative sources of revenue for the two nation states</li> <li>• To comply with existing treaties, statutes and conventions</li> <li>• To determine abundance and distribution so as to sustainably explore and exploit</li> <li>• To tap from the experiences of the smaller partner being an archipelagic state and independent experts with a view to establishing a robust regime</li> <li>• To attract credible and long term investors to invest in the zone</li> <li>• To ensure convergence with other stakeholders’ policies in the zone</li> <li>• To design initiatives and interventions capable of preventing and controlling IUU fishing</li> </ul>

### 7.2.3 Nature of fishing within the JDZ

Analysis of the data on the JDZ fisheries management regime in existence has revealed that currently there is no regime in place yet after being in operation for over a decade indicating lack of attention to marine living resources of the zone as highlighted in Section 6.5.1 with all the attendant consequences of pollution (Ukwe & Ibe, 2010). This is also a clear violation of Article 8 of the JDZ treaty as detailed in Section 6.8. This was equally re-echoed by almost all the other stakeholders who revealed ignorance of the existence of such a regime thereby negating the principle of adequate stakeholders' participation (Rice & Rochet, 2005). It is also a violation of continuous engagement of stakeholders in establishing marine fishery assessment and management (Potts, 2006; Beliaeff & Pelletier, 2011) in line with indicator development requirements and principles of ecosystem based fishery management.

On the legitimate practitioners that should be responsible for the regime, the analysis revealed that a variety of practitioners (Rice & Rochet, 2005; Potts, 2006; Gaichas, 2008; Beliaeff & Pelletier, 2011) in line with principles and requirements of marine indicator based assessments and management should be responsible for the regime when it comes into existence. However, the JDA believe only them and some international organisations such as the FAO and the Norwegian institute of marine research should be responsible for the regime. While the NBC supports the expansion of the responsibility to include the JMC in addition to the fisheries departments of the two countries and civil societies. The Fisheries Departments of Nigeria and STP believe practitioners should include the navy, maritime police and NIMASA from the Nigerian side in conjunction with their STP counterparts and all the ministerial and governmental departments from the STP side respectively. Similarly the Nigerian Navy suggested the inclusion of the National Trawlers Owners Association, NIOMR and NIMASA in addition to the ones previously mentioned. Furthermore, NIOMR stakeholders supports the inclusion of the DPR, the NNPC, the NPA in addition to the two countries Fisheries Departments as depicted in Table 6.12 of Section 6.5.2.

On the existence of a licencing or quota system; the analyses revealed the absence of a licencing quota presently but it is envisaged that the expected regime shall consist of a licencing and quota system. The assignment of property rights, control or licencing over marine living resources have long been earmarked as critical to their management since the abolition of open access at the dawn of the nineteenth century (Sherman, 1986; Alexander, 1993; Garcia & Hayashi, 2000). This was further confirmed from the JDA when they informed the survey of their intention to embark on licencing of competent operators after the analyses of their preliminary survey and inputs from the fisheries department of the two nations as highlighted in Table 6.13 of Section 6.5.3. However, the Fisheries Department of Nigeria has a licencing system in place for Nigerian waters but does not cover the JDZ. This brought to the fore issues of jurisdiction between and among the identified stakeholders from across the two divides capable of generating confusion. It is in an effort to foreclose such potential that the JDA revealed in the survey its intention to seek for permission to encroach into each of the countries' EEZs as a result of the transboundary nature of marine living resources (Juda, 1986; Higgins, 1991; Joyner, 2000). This was with a view to establishing a flexible licencing regime in line with principles of cooperation as encouraged by the provisions of Chapter 17, Agenda 21 (Potts, 2006).

Analysis of the data on stakeholders' contribution to ensure JDZ fisheries sustainability revealed uncoordinated inputs from across the broad range of participants devoid of integration as typified by the concept of sustainability (Sherman, 1995; Potts, 2006) and framework for indicator-based assessment techniques (Rice & Rochet, 2005; Potts, 2006; FAO, 2011). While the JDA put forward its contributions as monitoring, constant review of international policies and conduct of periodic stocks assessments; its current stage of fisheries development contradicts such propositions. Similarly, the Fisheries Department of Nigeria highlighted adherence to management plans as its contribution and its STP counterpart was unable to identify where and in what place its contributions may fit citing lack of robust working relationships between them and the JDA for this inability. It is important to note however that inter-stakeholder cooperation and

collaboration (Sherman, 1995; Sherman et al., 2009; Rice & Rochet, 2005; Potts, 2006) has been identified as a necessary ingredient for indicator-based marine fishery sustainability assessments and management as well as for ensuring ecosystem based fisheries management (Wang, 2004; Garcia & Cochrane, 2005; Christie et al., 2007). Others are the productivity centre and the NIOMR whose contributions are deployment of remote sensing instruments for detection of IUU fishing activities, measurement of sea surface temperature and production of useful and reliable data for Nigerian waters respectively as indicated in Table 6.14 of Section 6.5.4.

A brief overview of the situation regarding the current situation and the nature of fishing within the JDZ based on the analysed results from the survey conducted is presented in Table 7.2.

Table 7.2: Situation of the fisheries within the JDZ (Source: Author’s own)

<b>Nature of fishing within the JDZ</b>
<ul style="list-style-type: none"> <li>• Absence of a substantive regime after over a decade of operations</li> <li>• Lack of consensus among various stakeholders as to who should be the legitimate practitioners responsible for the proposed regime</li> <li>• Currently, no licensing or quota system in place due to the absence of a substantive regime but envisaged one</li> <li>• Sporadic and varied contributions to ensure resource sustainability among the identified stakeholders</li> <li>• Fishing activity around the zone currently uncoordinated, uncontrolled and unmonitored</li> </ul>

#### **7.2.4 Nature of IUU fishing around the JDZ**

The main sources of IUU fishing as revealed by the JDA and almost all the other stakeholders are from the Spanish, Chinese, and South Korea, Japanese, Korea and EU vessels and others flying flags of convenience as depicted in Table 6.15 of Section 6.6.1. This conformed to the viewpoint of most scholars such as Erceg, (2006) and Falaye (2008) on the IUU fishing prevalence around developing countries EEZs and most especially West African countries respectively.

While the analysis of the sources of IUU fishing prevalence was largely unanimous between and among almost all the survey participants; the percentage and type of fishery resources that suffers due to IUU fishing however varied from across the range of stakeholders. The majority were of the view that the type that suffers most is mainly tuna, others mentioned shrimps as shown in Table 6.16 of Section 6.6.2, but none of the data shed any light on the actual percentage citing dearth of requisite technologies and policing capacities to be able to provide an actual percentage; a very important requirement in curbing and mitigating IUU fishing activities (Erceg, 2006; Penteriani et al., 2010; Polacheck, 2012).

Analysis of the data from the JDA, Fisheries Department of Nigeria, NIOMR, the Nigerian Navy and the independent stakeholder on the organisations and parties involved in the downstream trading, management and handling IUU fishing catches revealed them as the maritime security agencies of the two nations, NIMASA from the Nigerian side and the perpetrators. The Nigerian Navy went further to assert that the perpetrators of IUU fishing mainly succeed as a result of their unholy alliance between them and some unscrupulous persons in conjunction with some governmental personnel responsible for landing and inspection as outlined in Table 6.17 of Section 6.6.3.

A variety of stakeholders' roles in the IUU fishing management as revealed by the analysis was found to be hampered by incoherent institutional arrangement as shown in Table 6.18 of Section 6.6.4, thereby impeding mitigating initiatives as required for effective management of IUU fishing activities (Erceg, 2006; Trouillet et al., 2011). While the most important stakeholder (the JDA) reiterated its inability to provide sufficient IUU fishing management due to the current stage of JDZ fisheries, they signified their intention towards establishing joint security and policing outfit between them and the maritime security agencies of the two nations with a view to providing adequate security and protection of the JDZ resources. Other stakeholders' roles such as the NBC are mainly advisory; the fisheries departments of the two nations' are in creation of deterrence through licencing, monitoring and control of vessels. As important as these measures may appear, they are actually inadequate if IUU fishing activities are to be deterred (Erceg, 2006; Penteriani et al.,

2010; Trouillet et al., 2011; Polacheck, 2012) as more stringent measures such as apprehension and stiff punishment of offenders are important in creation of deterrence.

On the issue of employment of technology to manage IUU fishing around the JDZ; the analysis revealed that while the JDA does not seem to have or deploy any form of technology in managing the prevalence of IUU fishing around the JDZ, other stakeholders deploy a varied range of technological innovations in their quest to curb, minimize or mitigate the menace as visualised in Table 6.19 of Section 6.6.5. These include the NBC; which uses boats and employment of state measures during maritime boundaries delineation exercises between Nigeria and her maritime neighbours. The fisheries department of Nigeria deploy Vessel Monitoring Service (VMS) device to monitor a part of the country's EEZ. Their STP counterparts equally employ electronic monitoring system capable of effecting monitoring and control in line with basic IUU fishing mitigation strategies (Borit & Olsen, 2012; Polacheck, 2012). Others are sensors and transponders by the Productivity centre when it was in operation as well as Regional Maritime Awareness Capability (RMAC) centres by the Nigerian Navy. This conforms to, but not sufficient for effective monitoring and measures of apprehension of offenders (Borit & Olsen, 2012); most especially industrial scale offenders.

The relationships between stakeholders' IUU fishing management strategies with other stakeholders' strategies analysis revealed inadequate synergy between and amongst most of the stakeholders due to absence of trust, inadequate capacity and mutual suspicions. The lack of trust among fishery management stakeholders has been found to be counterproductive in fostering critical working relationships (Glenn et al., 2012) albeit as a result of unshared common vision and language as manifested in the Nigerian Navy and STP coastguard relationship. The former is an English speaking and the latter Portuguese. It is due to this lack of trust that some stakeholders such as the STP Fisheries Department declined response on the relationship between their strategies and others while NIOMR claimed lack of adequate capacity to develop any strategy respectively as illustrated in Table 6.20 of Section 6.6.6.

Many of the stakeholders' opinions revealed from the analysis comprise of a number of ways, interventions and strategies on how best IUU fishing can be curbed, controlled, managed or mitigated. These include measures suggested by various scholars such as strengthening cooperation (Erceg, 2006; Polacheck, 2012) between and among the maritime security agencies from across the entire Gulf of Guinea, persistent monitoring and inspection (Penteriani et al., 2010; Borit & Olsen, 2012), combined use of satellite technology (Borit & Olsen, 2012), response patrol boats and introduction of stringent fines on offenders to create deterrence (Erceg, 2006). Others are the conduct of a comprehensive survey for the determination of source, type, percentage, movement patterns and seasonal patterns in addition to training, education, sufficient funding for equipment and deployment of satellite-based tracking technologies among others as detailed in Table 6.21 of Section 6.6.7.

Other ways of curbing the IUU fishing activities around the JDZ area as revealed by the two countries fisheries departments and the NIOMR are the harmonisations of their individual mitigation strategies with one another through consistent periodic interactions with a view to keeping abreast with each other's policy innovations. This shall be in addition to setting up a dedicated patrol/ observer programme for improved monitoring, inspection and surveillance in line with global best practices (Osterblom & Bodin, 2012). As well as seeking the cooperation of partners with existing fishery agreements (Gagern & Bergh, 2013) with some of the countries within the GCLME such as the STP; which has a number of partnerships with the EU and other developed countries. This is because most reported incidences of IUU fishing activities have been traced to the European, Asian and Russian vessels as reported in section 6.6.1 and this section. As such, cooperating with the legitimate partners from these nations may help in combating the menace of the IUU fishing activities traced to vessels from them.

However, most or all interventions would largely succeed if implemented alongside 'promising tools' such as establishment of a marine protected area and wider engagement of the resource managers with scientific measures (Vincent & Harris, 2014). This is so that a broad spectrum of mitigation measures capable of managing IUU fishing activities may be institutionalised. This form of intervention may as well

require the cooperation of other stakeholders beyond the JDZ areas as transboundary marine living resources such as fisheries appeared boundless no more (Vincent & Harris, 2014); which again brought to the fore the question of jurisdiction as highlighted earlier in Section 6.3.5. This is because combining these measures which cut across jurisdictions often with varying degrees of institutional arrangements may be impeded by political will and enthusiasm which can jeopardise the success of such interventions (Hosch, Ferraro & Failler, 2011). However, none of the stakeholders highlighted the need for this combination of arrangements as it pertained to creation of a functional synergy between and among critical stakeholders so as to muster their political will, commitment and ease of control and administration for seamless implementation of interventions.

Table 7.3 provides a brief overview of the situation and issues involved regarding the nature of the IUU fishing prevalence around the JDZ based on the analysed results from the survey:

Table 7.3: The reality of IUU fishing activities (sources and current situation) around the Nigeria-Sao Tome & Principe JDZ (Source: Author's own)

<b>Nature of IUU fishing around the JDZ</b>
<ul style="list-style-type: none"> <li>• Sources of IUU fishing unanimously believed to from mostly EU and Asian vessels</li> <li>• Percentage of species affected unknown but types mainly believed to be tuna and shrimps</li> <li>• Prevails partly due to an unholy alliance between governmental personnel and the perpetrators</li> <li>• Roles of stakeholders in its management marred by incoherent institutional arrangements and hampered by the absence of a substantive regime in place</li> <li>• Sporadic and varied deployment of technology in its management based on stakeholders' spheres of jurisdiction</li> <li>• Evidence of uncoordinated monitoring across range of stakeholders raising concerns over issues of jurisdiction; although JDA by itself yet to deploy any</li> <li>• Lack of synergy between individual stakeholder's management strategies occasioned by distrust, inadequate capacity and mutual suspicions</li> <li>• All stakeholders unanimously believe strengthening cooperation, use of satellite technology, persistent inspection and stringent fines are the best ways of curbing, controlling or mitigating the menace</li> </ul>

### **7.2.5 Level of awareness/ deployment of indicators**

The analysis of the survey results indicated non-deployment of the TWAP LME indicators for marine fishery sustainability assessment currently. However, a number of stakeholders such as the fisheries department of Nigeria, their STP counterparts and the Nigerian Navy as depicted in Table 6.22 of Section 6.7.1 are aware of adoption of sustainability agenda such as Agenda 21. This is because almost all the GCLME countries are signatories to the UNCLOS which requires nation states to adopt its declarations and commitments such as Agenda 21 within their sustainable development initiatives (Sherman, 1995; Garcia & Hayashi, 2000; Joyner, 2000; Sherman, 2006).

Similarly, among all the stakeholders' analysis only the Productivity Centre, NIOMR and the independent stakeholder are aware of the existence of an indicator-based

sustainability assessment within the Gulf of Guinea and not for the JDZ fisheries management (Table 6.23 of Section 6.7.2). It is noteworthy that the survey equally revealed the abrupt termination of the GCLME GEF supported indicator-based project for the GCLME due to lack of commitment from across the region's partners. This is despite the call, incorporation and adoption of indicator-based marine resource sustainability assessment (Sneddon, Howarth & Norgaard, 2006; Lescrauwaet et al., 2006; Heink & Kowarik, 2010) over almost three decades ago and in spite of its being institutionalised within international conventions and commitments (Sherman & Duda, 1999; McGlade et al., 2002; Lescrauwaet et al., 2006; Sherman, 2006) (Section 3.6).

There were a variety of submissions based on the types of indicators employed by stakeholders to contribute to sustainability assessments around the JDZ and they were all based on each stakeholder's area of jurisdiction as well as its understanding of indicators as shown in Table 6.24 of Section 6.7.3. The submissions are by no means to be taken for the JDZ assessments however, but for their individual situations and deployment. These indicators include periodic reports on catches by the NBC Nigeria only when it embarks on maritime boundary delineation exercises thereby revealing inconsistency as it is not continuous (Lescrauwaet et al., 2006). Others include deployment of VMS to monitor fish landings by the Fisheries Department of Nigeria but only for Nigerian waters revealing lack of credibility (Heink & Kowarik, 2010) and the NIOMR uses MSY and size variation but only for the Nigerian waters without the capacity of covering the JDZ. This is in addition to the Nigerian Navy which measures or perceives indicators based on its standard operating procedures as a yardstick for the protection and security of the Nigerian waters. Similarly, the productivity centre was established to serve as one of the regional activity centres for the GCLME before the termination of the project.

These fragmentations and inconsistencies are incompatible with the principle of integration as enshrined within the sustainability paradigm, the ecosystem-based fishery management doctrine and indicator-based marine sustainability assessment and management of transboundary marine resources (Smith, 1992; Garcia &

Cochrane, 2005; Christie et al., 2007; Douvère & Ehler, 2009; Aanesen, Armstrong & Hoof, 2012; Ban et al., 2014).

Although, the analysis revealed a number of measures taken by stakeholders to ensure the institutionalisation of indicator-based sustainability assessments (Table 6.25 of Section 6.7.4), it could be asserted that such measures are not enough, harmonised, sufficient and are inconsistent with adequate stakeholder engagement required of indicator development (Rice & Rochet, 2005). This is because there was a clear absence of cooperation between and among the stakeholders. This jeopardises sufficient avenues for information sharing as required for transboundary marine resource sustainability assessment and management (Breton, 2006; Lescauwaet et al., 2006; Ukwe, Ibe & Sherman, 2006; Sherman, 2014; Broggiato et al., 2014) and a prerequisite for adopting ecosystem-based fishery management.

On the issue of stakeholders' liaison with other stakeholders to develop indicator-based sustainability assessment it was revealed that the most critical stakeholder (i.e. the JDA) is in liaison with the Norwegian Institute of Marine Research and the FAO (Table 6.26 of Section 6.7.5). This is part of its on-going consultations towards the development of indicators as required for development of indicators (Leslie & McLeod, 2007) so as to build capacities. They however reported unsuccessful attempts towards fostering a relationship with Russia and some EU countries in their drive to benefit from advanced experiences.

Similarly, the Fisheries Department of Nigeria is in liaison with the COMHAFAT/ATLAFCO, the FCWC, the FAO and the EAF-Nansen projects in developing indicator-based sustainability assessment for the Nigerian waters. Whereas, their STP counterpart are not in liaison with any stakeholder to develop such but were of the view that indicator-based assessment is important for sustainable management and assessment of the JDZ fisheries resources. Others such as the Nigerian Navy are in liaison with only Nigerian stakeholders in line with the requirements of the Nigeria's Sea Fisheries Act for collaboration with a view to achieving sustainability focused on the Nigerian waters. NIOMR revealed cooperation with the 16 countries of the

GCLME but not for the JDZ specifically due to issues of jurisdiction over the zone as highlighted in various sections of this thesis. The productivity centre, while in operation was in liaison with the NOAA and the UBC Sea around Us project as partners, but whether that cooperation continues will depend on the reactivation of the entire GCLME project. This is because the independent stakeholder hinted of the likely re-activation of the GCLME project due to the initial successes prior to its halt.

From the foregoing, it is important to note that the fragmented liaisons by the various stakeholders would need to be coalesced with a view to harmonising various individual stakeholders' collaboration. This is to ensure a unified arrangement for the adoption of uniform indicators capable of providing an ideal platform for the sustainable assessment and management of the JDZ fisheries. This can in turn simplify or settle the issue of jurisdiction re-echoed by several stakeholders in terms of their inputs towards consensual contribution for the sustainable, indicator-based marine fishery management and assessment of the JDZ.

A summary of the issues observed from the analysed survey results on the level of awareness and or deployment of indicators by stakeholders is depicted in Table 7.4.

Table 7.4: Positions of indicators awareness and deployment (Source: Author's own)

Level of awareness/deployment of indicators
<ul style="list-style-type: none"> <li>• Appreciable level of awareness of sustainability issues such as Agenda 21</li> <li>• Only few among stakeholders are aware of indicator-based sustainability assessment within the Gulf of Guinea: Note that the GCLME project has stopped</li> <li>• There is currently no indicator-based sustainability assessment or agenda in place for the JDZ fisheries</li> <li>• Few attempts exist based stakeholders' situation and areas of jurisdiction such as periodic reports on catches, deployment of VMS to monitor fish landings, MSY and size variation</li> <li>• None of those attempts covers or transcends the JDZ area</li> <li>• Almost all the stakeholders currently in liaison with other stakeholders to develop capacity with a view to ensuring indicator-based sustainability assessment in future</li> </ul>

The evaluation of the attempted indicators against ideal indicator requirements is presented in Section 8.4 based on scoring assigned to the indicators by the JDA.

### **7.3 Ideal indicator requirements for examining marine fisheries sustainability**

While it has been asserted that there is no single perfect definition of 'indicator' by several scholars (Section 2.11); there is in place equally varying though synonymous interpretations of indicator requirements, characteristics and properties (Meadows, 1998; Garcia, Staples & Chesson, 2000; Salas et al., 2006). This is due to the consensus that indicators must be tailored to their expected use (Cordar, 2001). Others, such as Lescauwaet et al. (2006) and Heink & Kowarik (2010) put forward some criteria for a sound indicator (Section 2.11.1).

Institutional interventions by international organisations such as the FAO (2011) put forward a number of evaluation criteria supported by a host of scholars including Berkes & Jolly (2001), Prescott-Allen (2001), Garcia et al. (2003) and Rice & Rochet (2005). These requirements comprise of data availability, practicality, cost-effectiveness, comprehension, acceptability by stakeholders and robustness.

### **7.3.1 Data availability**

According to the FAO (2011), for an indicator to meet evaluation criteria it must consist of data that are readily available, established and published by reputable international institutions such as the UN, its partners, academic community and other related publications. It went further by defining the data based on the reputation of its repository and assignment of scoring system of one to three. Where the highest score is assigned to data sets published by the UN and the lowest score assigned to a set of data that needed to be assembled primarily. This conforms to the arrangements imbued in the LME concept as put forward by a number of scholars such as Sherman et al. (2009) and other international institutions such as IOC-UNESCO (2011).

### **7.3.2 Practicality**

An indicator must be able to be deployed in the actual sense rather than theoretically (FAO, 2011). This is to ensure its ability to combine numerous environmental factors into a single value becomes manifest thereby making the formulation of ecological concepts and delivery of management strategies easy and straight forward (Salas et al., 2006). As such, an indicator has to be practical and tailored to its intended use so that stakeholders (users) are adequately informed of its evolutionary processes (Rice & Rochet, 2005) thereby making the development phases transparent and interactive with potential users. Therefore, any indicator that is not practicably implementable but only grounded in theory is of no use and should not be considered and discarded (Rice & Rochet, 2005; Salas et al., 2006).

### **7.3.3 Cost-effectiveness**

This is a requirement which an indicator must possess for it to be affordable. In a situation where data for an indicator exists but extremely expensive to access makes that indicator invaluable for potential or designated users thereby defeating the very essence of its development (FAO, 2011). Just as indicators must be tailored to their expected use (Salas et al., 2006) for simplification and communication of information (Cordar, 2001); it must also be affordable for the intended user if its adoption, consolidation and deployment are to be guaranteed (Lescrauwaet et al., 2006; FAO, 2011). Otherwise, the exercise might end up in futility where the

designated users or potential users to which the indicator was developed for are unable to afford it.

#### **7.3.4 Comprehensiveness**

This is akin to the popularity of the indicator within the user community such that its construction and subsequent introduction to potential users (FAO, 2011) does not require elaborate or tedious interpretation. It is equally assigned a scoring criteria comprising of 'highest' to 'lowest'; where recognised indicators score the highest, the less acclaimed score medium and the complex or synthesized score the lowest (FAO, 2003; Garcia et al., 2003; FAO, 2011). Therefore, the more closely familiar the potential user is to the indicator, the more likely they are to adopt and implement it for decision rules. As such complexities in indicator development should be avoided where possible, otherwise it is unlikely to be adopted and subsequently implemented (Rice & Rochet, 2005; Lescrauwaet et al., 2006).

#### **7.3.5 Acceptability by stakeholders**

Several scholars engaged in the studies of indicator development such as Rice & Rochet (2005), Salas et al., (2006), Lescrauwaet et al. (2006) and Heink & Kowarik (2010) have all stressed the importance of stakeholder interaction so that the end result becomes readily acceptable by the potential users. This is because there is no use in developing indicators that end up not being used or accepted by the target user-groups. The FAO (2011) went further to assign scoring pattern of one to three as in the previous requirements. Those with a comprehensive or universal acceptance were given the score of three; those with recognition only within their discipline were assigned the score of two while those found to be contentious were scored one (FAO, 2011). It is believed that the GEF-funded GCLME project established its three regional activity centres across the West African sub-region distributed randomly within the countries partly to ensure its proposed modular suites of indicators become readily acceptable when the project commenced (Ukwe, Ibe & Sherman, 2006).

### **7.3.6 Robustness**

The ability of an indicator to withstand rigorous intellectual scrutiny has been identified as its robustness (FAO, 2011). This gives it the capacity to translate realities, physical and social science knowledge into manageable & measurable units of information easily understandable to end-users of different scientific, educational and institutional backgrounds (Lescrauwaet et al., 2006). An indicator should ideally be able to provide simple and clear data capable of indicating items and trends that are obviously relevant in terms of sustainable policies. This is of utmost importance in the marine area where the issues and ecosystems could be complex and integrating policy formulation, decision making and management are particularly difficult (FAO, 2003; Rice & Rochet, 2005; Lescrauwaet et al., 2006) and sometimes unpredictable.

## **7.4 Evaluating the current levels of indicator deployment for the JDZ fisheries against ideal indicator requirements**

The current levels and situation of the JDZ fisheries management comprising of the management structure, management policies adopted for JDZ fisheries, nature of fishing within the JDZ, nature of IUU fishing around the JDZ and level of awareness/employment of indicators are evaluated (Sections 7.2 to 7.2.5).

It is noteworthy however that the only indicators being currently employed are those in use albeit periodically and for different purposes by individual stakeholders around the JDZ and not specifically for its marine fishery assessment (Section 7.2.5). More so, these indicators do not represent the indicators contained in the TWAP-LME indicators series. They are an amalgamation of sporadic sets of indicators being employed by the surveyed stakeholders based on their employment of an indicator-based assessment.

The level of the awareness and or employment of indicators for the JDZ fisheries by stakeholders are hereby evaluated against each of the ideal indicator requirements so as to determine their appropriate situations based on the requirements for developing indicators (FAO, 2003; Rice & Rochet, 2005; Lescrauwaet et al., 2006). Each of the indicators is scored with high (H), medium (M) and low (L) probabilities

depicting its situation (Berkes & Jolly, 2001; Garcia et al., 2003 and Rice & Rochet, 2005; FAO, 2011). This is based on the analysed data for the said indicator obtained from the survey. It is also to show the simplicity, difficulty and possibility of developing the current indicators based on internationally and academically acceptable procedures for indicator development (Rice & Rochet, 2005; Lescrauwaet et al., 2006; FAO, 2011).

This is to highlight the current situation each of the employed indicators faced against the ideal requirements made up of data capacity, practicality, cost-effectiveness, comprehensiveness, acceptability by stakeholders and robustness in line with the analysed results as depicted in Table 7.5.

Table 7.5: Current levels of indicator deployment for the JDZ fisheries against ideal indicator development requirements (Source: Author's own)

*Current levels of indicators deployment for the JDZ fisheries	Ideal Indicator Requirements					
	Data Availability	Practicality	Cost-effectiveness	Comprehensiveness	Acceptability by Stakeholders	Robustness
• Periodic reports on catches	M	M	M-H	M	L-M	L
• Deployment of VMS to monitor fish landings	M-H	M	H	L-M	L-M	M
• Determination of M.S.Y.	L-M	M-H	M-H	H	L-M	H
• Mesh Size Variation	L	L-M	L-M	M-H	M-H	M
• Standard Operating Procedures by the Nigerian Navy for protection & Security	L-M	M-H	M-H	L	L	L

\*Note that these indicators were not reported by the JDA but by other stakeholders around the JDZ as reported in Sections 6.7.3 and 7.2.5.

## **7.5 Evaluation of the JDZ indicator performance against other models**

In evaluating the JDZ indicators performance against other models; it is instructive to reiterate that while there may be some similar models such as Buuren et al., (2002); Henocque, (2003); Himes, (2005) and Potts, (2006) that employ indicators to examine or measure marine resource sustainability (Table 3.2 of Section 3.8). Those models however focused on small units of assessments or national units within a single nation as opposed to shared marine fishery assessments under a joint development arrangement using indicators.

Similarly, there are quite a number of joint development arrangements such as the Anglo-Norwegian Joint Development arrangement, the Norwegian-Russian Joint Commission on Fisheries, the Colombia-Jamaica Joint Development Zone, the Barbados-Guyana Joint Development Zone and the Senegal-Guinea-Bissau Joint Development Zone (Sections 3.11.2, 3.11.3, 3.11.4, 3.11.5 and 3.11.6 respectively).

But none these arrangements have their marine fishery resources assessed or examined through the use of indicators as highlighted in Section 3.9 in addition to the fact that indicators for specifically assessing areas of sub-LME scale are yet to be developed (IOC-UNESCO, 2011). This is why an evaluation and monitoring framework on how indicators are used and applied in similar scenarios has long been established as a research gap (Lyytimaki & Rosenstrom, 2007) that needed to be filled (Section 3.8).

As such, the JDZ model will first be evaluated against other similarly highlighted Joint Development arrangements. Secondly, it will then be evaluated against other similar models that focused on a single unit or single nation assessment as a result of the absence of a shared arrangement that employs an indicator-based assessment.

The Nigeria-Sao Tome & Principe JDZ has a number of similarities with other joint development arrangements such as (Sections 3.11.2 to 3.11.6). There are some differences based on historical evolution or based on the focus or determination of stipulated area as (Table 7.6).

Table 7.6: Comparison of other joint development arrangements with Nigeria-Sao Tome & Principe JDZ (Source: Author's own)

JDZ Models	Nigeria-Sao Tome JDZ	Anglo-Norwegian JDA	Norwegian-Russian JCF	Colombia-Jamaica JDZ	Barbados-Guyana JDZ	Senegal-Guinea-Bissau JDZ
Date of establishment	2001	1965	1976	1993	2003	1993
Resources in the Zone	Marine living and non-living	Marine living and non-living	Mainly marine fishery	Marine living and non-living	Mainly marine fishery	Marine living and non-living
Location of the Zone	Gulf of Guinea	North Sea	Barents Sea	Caribbean Sea	Caribbean Sea	Gulf of Guinea
Reason for cooperation	Disputed area of overlap	Disputed area of overlap	Fishing rights	Disputed area	Delimitation dispute	Jurisdictional dispute
Validity period	45 years	Unclear	Unclear	Unspecified	Unlimited	20 years
Sharing formula/ratio	60:40	Unspecified	50:50	Unspecified	50:50	85:15

Similarly, the JDZ indicator performance as it currently stands as depicted in Sections 7.2.5 and 7.4 can be said to be distinctive with few similarities from the models highlighted as detailed in Section 3.8. The distinction and similarities between the JDZ indicator performance and the identified models are as demonstrated in Table 7.7.

Table 7.7: Distinction between the JDZ and other models (Source: Author's own)

Issue compared	The Nigeria-Sao Tome & Principe JDZ	European Coastal Environment	French Coastal Zone	Egadi Island MPA in Italy	Australian & MSC Initiative
Focus	Shared resource assessment	Multiple but Unshared resource assessment	Unshared resource assessment	Unshared resource assessment	Multiple but Unshared resource assessment
Indicator deployment	Catches, VMS, Mesh size and MSY	ICZM progress and sustainability	ICM process indicators	MPA performance indicators	SIS indicator system
Coverage	A shared JDZ between two countries EEZ	Mediterranean coastal zone nations	Five areas along French Atlantic coast	A single marine reserve	Australian fisheries & MSC initiatives
Resource type	Marine fishery	Coastal & Marine fisheries	Coastal fishery	General marine resources	Coastal & Marine fisheries
Resource Ownership	Two sovereign nations	Individual sovereign nations	Single nation state	Single nation state	Multiple nation states

Section 7.6 will identify the practical steps to be followed in establishing a good system of indicator-based marine fisheries management regime with a view to constructing an ideal set of recommendations for a sustainable fisheries management initiative for the JDZ fisheries.

## **7.6 Practical steps of establishing a good system of indicator-based fisheries management scheme or regime**

The framework put forward by Rice & Rochet, (2005) comprising of detailed steps for selecting a suite of indicators for marine fisheries sustainability assessment will be adopted. This is based on its acceptability by scholars such as Rice & Rivard, (2007), Rochet et al., (2007), Shin et al., (2010), Beliaeff & Pelletier (2011) and Tzanatos et al., (2013) as well as international institutions such as FAO, (2011).

They consist of eight steps namely; identification of the user groups and their needs, drawing list of candidate indicators, assigning weighting criteria for the candidate indicators, scoring of the candidate indicators against the criteria, summarising the results, deciding how many indicators are needed, final selection of indicators and presentation of the information to the end users.

- Step 1: The identification of the user groups and their needs entails determination of who are the users; comprising of both the managers and stakeholders since almost all aspects of fishery are influenced by the practicality of the variety of indicators (FAO, 2003; FAO, 2011). Although management objectives may appear general or even vague thereby providing little or no direction in the selection of indicator, it is very important however to first ensure objectives are adequately formulated in such a way that potential users are and feel sufficiently involved in the selection and development of the indicators.
- Step 2: Developing list of candidate indicators by including indicators that really measure the state of ecosystem in relation to the objectives set out from the onset. This entails taking into account the values attached to the resources, their characteristics and exploitation trends in line with the knowledge possessed of the ecosystem they inhabit. If the management objectives are already set, then a list can be developed to reflect each of those objectives; otherwise technical expertise in addition to careful and painstaking exercise may be required so that all potential effects of fishing on ecosystem and vice versa are examined.

- Step 3: The assignment of weighting criteria to the candidate indicators is done by determining the screening based on some nine criteria (Rice & Rochet, 2005) or ten (FAO, 2011); although all of them may not possess the same importance but efforts should be made to ensure their utilisation. As values attached to each of the criteria may be different between and among those involved with the governance, it is very important to establish the relative importance attached (minor, moderate or high) to the criteria in terms of the set objectives before embarking on the screening so as to maintain objectivity of the whole process. The weighting criteria are concreteness, theoretical basis, public awareness, cost, measurement, historical data, sensitivity, responsiveness and specificity (Rice & Rochet, 2005) and the additional one included by the FAO is reference points (FAO, 2011).
- Step 4: Scoring the indicators against the criteria is done by assigning scores based on screening conducted in the form of either the quality possessed by each indicator based on the criterion or by appraising its information content so that values are assigned to each indicator for ranking. An ordinal score of either 1 to 4 reflecting low, fair, moderate and high respectively may be adopted thereby representing each of the criteria that are assigned within the screening.
- Step 5: Summary of the results should be comprised of two matrices, one consisting of the weights assigned to each of the indicators based on the criteria and the other containing the scores given to each indicator by any of the given criterion. This will make each indicator to maintain evidence of a designated weight and information quality based on varying dimensions of the criterion used in addition to a clear distinction based the scores represented.
- Step 6: In deciding the number of indicators needed, an inclusive interaction among the users is highly recommended so that governance and management objectives are fully adopted in the decision processes as already emphasised in stages 1 and 2. It is also important and advisable to decide on the fewest number of indicators that possess multiple components represented by the objectives. This could be aided by effectively figuring the performance of the

candidate indicators based on the scores and weightings in the evaluation criteria, but most importantly is the reflection of the user objectives.

- Step 7: In making the final selection; what needs to be considered are those set of indicators that were outstanding in scores against each of the criteria for their intended use in addition to satisfying the social, economic and ecological objectives set from the beginning. In a situation where no candidate indicator scores beyond average, then balancing of strengths and weaknesses need to be taken as a yardstick for the selection. This is based on the expectation that performance of all candidate indicators against weights and scores varies from one to another and where the intention for the inclusion of an indicator is for multiple purposes, and then their selection based on intended use shall take precedence before generating a compromise among uses. Also reasons for the selection should be recorded and maintained because strengths and weaknesses may change over time and for different purposes and scenarios thereby ensuring flexibility when revisiting becomes imperative.
- Step 8: While there may be several reporting or presentation methods, it is recommended that a standardised method of presentation shall consist of all the steps taken in selecting appropriate suite of indicators. These may include the identification technique, the development criteria, how weights were assigned to the criteria, how each criterion was scored, the summarised values, decision on a number of candidate indicators and rationale behind the final selection. This is to avoid the confusion capable of emanating from adopting multiple integrating methods based on each situation which has the potential of re-establishing complications in some of the stages most especially stages 3 to 6. It also foreclosed entanglement issues associated with several reporting systems (Rice & Rochet, 2005) where different expected uses are to be reported (Rochet & Rice, 2005).

## **7.7 Outcomes based on the evaluations for the JDA feedback/comments**

In line with the aim of the research and the current situation of the JDZ fisheries as observed in Section 6.8.1 based from the analysed data, the outcome that is to be put forward for the JDA will comprise of the TWAP-LME set of indicators. Firstly, they are expected to be scored against the ideal indicator requirements and secondly, the indicators, against their adaptability of the stages involved in an indicator-based fishery management regime. The outcomes document (See Appendix Six) consists of the information on the feedback/comments expected, detailed description of the indicators, information on the weighting and scoring criteria as well as two tables.

The first itemises the TWAP-LME indicators in one column with other columns containing the ideal indicator requirements for the JDA management to provide feedback/comments on the status of each indicator in line with their current status, capabilities and preparedness as shown in Table 7.8.

Table 7.8: TWAP-LME Indicators with the corresponding ideal indicator requirements  
(Source: Author's own)

TWAP-LME INDICATORS	DATA AVAILABILITY	PRACTICALITY	COST-EFFECTIVENESS	COMPREHENSIVENESS	ACCEPTABILITY	ROBUSTNESS
Primary Productivity						
Sea Surface Temperature						
Oceanographic Fronts						
Reported Landings						
Value of Reported Landings						
MTI & FIB						
Ecological Footprints of Fisheries						
Stock Status Plots						
Fishing Efforts						
Projected Catch Potential						
LME carrying capacity in relation to MSY						
Mercury Contamination						
Plastic Resin Pellets						
Nutrients Indicator						
Negative Trends in Dissolved Oxygen Concentration						
Shipping Density						
Harmful Algal Blooms (HABs)						
Freshwater Discharge						
Sediment Discharge						
Seamounts at Risk						
Change in Protected Area Coverage						
Change in extent of Mangrove Habitat						
GDP Fisheries						
Human Development Index (HDI)						
Deaths/100000 caused by climatic Disasters						
Marginal Economic Value (MEV)						

The second table shall contain the TWAP-LME indicators in one column and three other columns for them to tick on their chosen candidate indicators assign weights to each of the chosen candidate indicator and score the candidate indicators (stages 2-4) in line with their management and operational objectives as depicted in Table 7.9.

Table 7.9: TWAP-LME Indicators with corresponding weighting, choice and scoring criteria columns (Source: Author's own)

<b>TWAP-LME INDICATORS</b>	<b>Chosen Indicator</b>	<b>Assigned Weight</b>	<b>Score Given</b>
Primary Productivity			
Sea Surface Temperature			
Oceanographic Fronts			
Reported Landings			
Value of Reported Landings			
MTI & FIB			
Ecological Footprints of Fisheries			
Stock Status Plots			
Fishing Efforts			
Projected Catch Potential			
LME carrying capacity in relation to MSY			
Mercury Contamination			
Plastic Resin Pellets			
Nutrients Indicator			
Negative Trends in Dissolved Oxygen Concentration			
Shipping Density			
Harmful Algal Blooms (HABs)			
Freshwater Discharge			
Sediment Discharge			
Seamounts at Risk			
Change in Protected Area Coverage			
Change in extent of Mangrove Habitat			
GDP Fisheries			
Human Development Index (HDI)			
Deaths/100000 caused by climatic Disasters			
Marginal Economic Value (MEV)			

The JDA was equally encouraged to provide detailed feedback preferably outside the table template provided with a view to obtaining as much of their comments as possible.

The governance module indicator, which does not contain list of candidate indicators but based on some four orders of outcomes as already highlighted in Section 3.7.4 was integrated upon the receipt of the feedback/comments in line with its construction.

## **7.8 Feedback and comments from the JDA**

The request for feedback and comments was sent out to the JDA on the 9<sup>th</sup> of December, 2014 and the feedback was returned on the 26<sup>th</sup> of January, 2015. The feedback and comments document returned (Appendix Seven) consisted of a covering letter detailing the rationale behind the selection/choice of ideal indicators and the justification of their indicators' scoring.

It is noteworthy that the JDA does not classify the indicators based on the five modular suites as published in the TWAP-LME indicators methodology and as was transmitted to them. This categorised the indicators under the five modules, namely; productivity, fish & fisheries, pollution & ecosystems health, socioeconomics and governance. Rather, they classified their chosen indicators into two classes, namely; environmental and bio economic TWAP-LME indicators. They also provided the justification for their feedback and comments based on conduct of their preliminary marine survey of the JDZ, non-commencement of commercial fisheries and fisheries related activities, location of the JDZ and the reason for the scores given.

The indicators selected by the JDA and classified as TWAP-LME environmental indicators are the primary productivity, sea surface temperature, oceanographic fronts, mercury contamination, plastic resin pellets, nutrients indicator, negative trends in dissolved oxygen concentration, shipping density, harmful algal blooms (HABs), sediment discharge, seamounts at risk and marginal economic value in (Table 7.10) along their original classification in the TWAP-LME module categorisations.

Table 7.10: Environment indicators as classified by the JDA in their feedback/comments (Source: Author's own)

Environmental Indicators	Original TWAP-LME Module
Primary Productivity	Productivity
Sea Surface Temperature	Productivity
Oceanographic Fronts	Productivity
Mercury Contamination	Pollution & Ecosystems Health
Plastic Resin Pellets	Pollution & Ecosystems Health
Nutrients Indicator	Pollution & Ecosystems Health
Negative Trends in Dissolved Oxygen Concentration	Pollution & Ecosystems Health
Shipping Density	Pollution & Ecosystems Health
Harmful Algal Blooms (HABs)	Pollution & Ecosystems Health
Sediment Discharge	Pollution & Ecosystems Health
Marginal Economic Value	Socioeconomic

The bio economic TWAP-LME indicators earmarked by the JDA are currently not feasible due to the non-commencement of commercial fisheries and robust fisheries related activities. These include the reported landings, value of reported landings, MTI & FIB, ecological footprints of fisheries; stock status plots, fishing efforts, projected catch potentials, LME carrying capacity in relation to MSY and GDP fisheries as shown in Table 7.11 along with their original classification in the TWAP-LME module categorisations.

Table 7.11: Bio economic indicators as classified by the JDA in their feedback and comments (Source: Author's own)

Bio economic Indicators	Original TWAP-LME Module
Reported Landings	Fish & Fishery
Value of Reported Landings	Fish & Fishery
Mean Trophic Index (MTI) & Fish In Balance Index (FIB)	Fish & Fishery
Ecological Footprints of Fisheries	Fish & Fishery
Stock Status Plots	Fish & Fishery
Fishing Efforts	Fish & Fishery
Projected Catch Potential	Fish & Fishery
LME carrying capacity in relation to Maximum Sustainable Yield	Fish & Fishery
GDP Fisheries	Socioeconomic

While other indicators equally belonging to different modules, namely; change in protected area, change in extent of mangrove habitat, human development index (HDI) and deaths/100000 caused by climatic disasters were rejected as a result of the remoteness of the JDZ location (Appendix Seven).

Based on the request for feedback and comments sent to the JDA the TWAP-LME indicators table with the corresponding weighting, choice and scoring criteria column as (Table 7.9 of Section 7.7) was scored, filled and returned in which the choices were made, weights assigned and corresponding scores given.

The chosen environmental TWAP-LME indicators by the JDA randomly belong to different suites among the five modular suites as against the 'environmental' classification done by the JDA even though some may be truly considered environmental but were not identified and classified as such by the original developers and publishers as explicitly categorised by IOC-UNESCO. Similarly, the bio economic TWAP-LME indicators equally belong to a variety of modules in the original TWAP-LME modular categorisations as against the classification given by the JDA as 'bio economic'. The chosen indicators along with their assigned weights and scores by the JDA are detailed in Table 7.12.

Table 7.12: The JDA chosen indicators along with their assigned weights and scores (Source: Author's own)

TWAP-LME INDICATORS	Chosen Indicator	Assigned Weight	Score Given
Primary Productivity	✓	HIGH	4
Sea Surface Temperature	✓	HIGH	4
Oceanographic Fronts	✓	HIGH	4
Reported Landings	X	NIL	0
Value of Reported Landings	X	NIL	0
MTI & FIB	X	NIL	0
Ecological Footprints of Fisheries	X	NIL	0
Stock Status Plots	X	NIL	0
Fishing Efforts	X	NIL	0
Projected Catch Potential	X	NIL	0
LME carrying capacity in relation to MSY	X	NIL	0
Mercury Contamination	✓	HIGH	4
Plastic Resin Pellets	✓	HIGH	4
Nutrients Indicator	✓	HIGH	4
Negative Trends in Dissolved Oxygen Concentration	✓	HIGH	4
Shipping Density	✓	MODERATE	3
Harmful Algal Blooms (HABs)	✓	HIGH	4
Freshwater Discharge	X	NIL	0
Sediment Discharge	✓	FAIR	2
Seamounts at Risk	✓	FAIR	2
Change in Protected Area Coverage	X	NIL	0
Change in extent of Mangrove Habitat	X	NIL	0
GDP Fisheries	X	NIL	0
Human Development Index (HDI)	X	NIL	0
Deaths/100000 caused by climatic Disasters	X	NIL	0
Marginal Economic Value (MEV)	✓	HIGH	4

Based on the request for feedback and comments from the JDA in terms of the ideal indicators' requirements; the TWAP-LME indicators table along with the ideal requirements as (Table 7.8 of section 7.7) was filled and returned in which the current level of each indicator's requirements was scored in line with the JDA's current management capabilities.

As such, the JDA based their scoring on the indicator requirements, namely data availability, practicality, cost-effectiveness, comprehensiveness, acceptability and robustness of the indicators in relation to their current situations as well as the current conditions prevalent in the JDZ. Table 7.13 is based on the JDA's response and denotes which indicator possesses data, is practical, is cost-effective, is viewed as comprehensive, and is acceptable and perceived as robust.

Table 7.13: The JDA’s positions and situations of each of the ideal indicator requirements from the feedback and comments (Source: Author’s own)

TWAP-LME INDICATORS	DATA AVAILABILITY	PRACTICALITY	COST-EFFECTIVENESS	COMPREHENSIVENESS	ACCEPTABILITY	ROBUSTNESS
Primary Productivity	✓	✓	✓	✓	✓	✓
Sea Surface Temperature	✓	X	✓	✓	✓	✓
Oceanographic Fronts	✓	✓	✓	✓	✓	✓
Reported Landings	X	X	X	X	X	X
Value of Reported Landings	X	X	X	X	X	X
MTI & FIB	X	X	X	X	X	X
Ecological Footprints of Fisheries	X	X	X	X	X	X
Stock Status Plots	X	X	X	X	X	X
Fishing Efforts	X	X	X	X	X	X
Projected Catch Potential	X	X	X	X	X	X
LME carrying capacity in relation to MSY	X	X	X	X	X	X
Mercury Contamination	✓	✓	✓	✓	✓	✓
Plastic Resin Pellets	✓	✓	✓	✓	✓	✓
Nutrients Indicator	✓	✓	✓	✓	✓	✓
Negative Trends in Dissolved Oxygen Concentration	✓	✓	✓	✓	✓	✓
Shipping Density	✓	✓		✓	✓	✓
Harmful Algal Blooms (HABs)	✓	✓	✓	✓	✓	✓
Freshwater Discharge	X	X	X	X	X	X
Sediment Discharge	✓	✓	✓	✓	✓	✓
Seamounts at Risk	✓	✓	✓	✓	✓	✓
Change in Protected Area Coverage	X	X	X	X	X	X
Change in extent of Mangrove Habitat	X	X	X	X	X	X
GDP Fisheries	X	X	X	X	X	X
Human Development Index (HDI)	X	X	X	X	X	X
Deaths/100000 caused by climatic Disasters	X	X	X	X	X	X
Marine Economic Value (MEV)	✓	✓	✓	✓	✓	✓

## 7.9 Summary

Chapter Seven evaluated the analysed survey data against ideal indicator performance requirements with a view to establishing where and in what form the current the JDZ indicator deployment is lacking or optimal. It further evaluated the ideal requirements against the current indicator deployment for the JDZ fisheries as revealed from the analysis. It then established from the literature and best practices a step by step approach towards developing an indicator-based appropriate system of marine fishery assessment and management capable of being replicable within the JDZ and elsewhere. It also identified the outcomes that were organised based on the Identification and evaluation of a logical and practical sequencing of steps towards establishing an appropriate system of fisheries

management manifest by performance against the indicators. Lastly, it presented the outcomes and comments that were returned by the main stakeholders (the JDA) and interpreted their positions.

The next chapter will discuss the assessments by integrating the feedback and comments from the JDA and drawing from the implications, recommendations, suggestions and positions of the JDA in terms of their knowledge and deployment of indicators. This will be undertaken by identifying where the JDA as the marine fishery resources managers of the JDZ are optimal or sub-optimal based on their feedback and comments and upon triangulation with the thematic survey analyses. From this, critical insights and key lessons emerged based on their current management practices.

## **Chapter Eight: Viability assessments**

### **8.1 Introduction**

This chapter will discuss the feedback and comments that were returned by the JDA-see Appendix Seven-with a view to assessing their position based on their responses and its implications for the issue of knowledge and deployment of indicators in their current JDA fishery management arrangements. Their choice of indicators justified by the weights assigned and the scores given will be examined so as to ensure their preferences are recognised in line with the requirements of indicators development and deployment.

Similarly, the JDA's choice of indicators based on the ideal indicator requirements of data availability, practicality, cost-effectiveness, comprehensiveness, acceptability and robustness will be examined with a view to deciphering from their justification, the choices made. This will make the identification of where and in what form the current arrangements are optimal or sub-optimal possible.

The identified position (optimality or sub-optimality) will then further be integrated into the thesis with a view to generating insights and lessons that may be applied to improve the sustainable JDZ marine fishery assessment manifest by indicators or in establishing an effective indicator-based marine fishery regime for the sustainable management and assessment of the JDZ fisheries.

### **8.2 Integrating feedback and comments from the JDA**

In evaluating the viability of implementing the TWAP-LME indicators to the JDZ, it is vital to put into perspective how the main resource managers (the JDA) perceive and deploy indicators generally and the TWAP-LME indicators in particular. Their perception, current use and deployment were obtained from the feedback and comments generated from the analysed surveys data. They are categorised into three main subsections, namely; the JDA selection of indicators based on ideal indicator requirements, the JDA scoring of and weights assigned to the chosen indicators and the level of the JDA indicators compliance in terms of the chosen indicators. Lastly, the optimality and sub-optimality of the TWAP-LME indicators

application to the JDZ by the JDA will be identified and integrated with a view to generating the current JDZ indicator-based management scenario.

### **8.2.1 The JDA selection of indicators based on ideal indicator requirements**

A total of twelve indicators were selected by the JDA based on their current management arrangements, capabilities and awareness. They were also chosen in accordance with the JDA's position in relation to the ideal indicator requirements as (Table 7.13 of Section 7.8). They made the choice according to the ability of the indicators to meet the ideal requirements, namely; data availability, practicality, cost-effectiveness, comprehensiveness, acceptability and robustness in terms of their application to the JDZ.

The twelve TWAP-LME indicators they selected which they classified as 'environmental' indicators are not necessarily currently being employed for the JDZ fisheries. However, they are based on the potentialities of identifying each of them from the results of the marine survey they conducted in conjunction with the Norwegian Institute of Marine Research. The marine survey of the bottom fauna, selected physical and chemical compounds was conducted for the JDZ in 2011 and 2012 which generated some quantitative data that the JDA believe may support the chosen twelve indicators when analysed. This perception or standpoint however, may not be acceptable in the procedures for indicator development. This requires a credible pattern of methodological arrangements (Rice & Rochet, 2005; Rochet & Rice, 2005; Lescrauwaet, 2006) and does not appear to consider the whole modules components of the TWAP-LME indicators (Sherman, 1986; Sherman, 2006; Sherman & Hempel, 2008; IOC-UNESCO, 2011) but may be unique only to the JDZ in accordance with their current fishery management arrangements in place. Despite this, it should be noted that they do not possess justifiable and credible methodologies based on their presentation by the JDA as required in the development of indicators (Rice & Rochet, 2005; Lescrauwaet, 2006; IOC-UNESCO, 2011). The TWAP-LME indicators' methodologies have been constructed by the IOC-UNESCO and presented in the volume 5 of the 'methodology for the GEF Transboundary Waters Assessment Programme and as depicted in Sections 3.6.4 to

3.7. However, the JDA considered the twelve chosen indicators as potentially practical, cost-effective, comprehensive, robust, acceptable and capable of generating the required data for their indicator-based assessments.

As such, the twelve chosen indicators were found by the JDA to fulfil the ideal indicator requirements (Appendix Seven) based on the selections contained in the feedback and comments from the JDA except the sea surface temperature. This was marked as impractical in the light of their current marine fishery management arrangements as in (Table 7.13 of Section 7.8) as a result of their inability to obtain timeline trends. This is in spite of the availability of sea surface temperature trends of over 50 years on the NOAA website as well as its construction's capability with the UK Meteorological Office-Hadley Centre as explained in Sections 3.6.4 to 3.7.

The seeming impracticality of implementing the 'sea surface temperature' indicator can however be resolved by obtaining the freely available global SST data from the UK meteorological office via <http://www.metoffice.gov.uk/research/areas/ocean-forecasting/data-assimilation> or [http://marine.copernicus.eu/web/69-interactive-catalogue.php?option=com\\_csw&view=details&product\\_id=SST\\_GLO\\_SST\\_L4\\_NRT\\_OBSERVATIONS\\_010\\_001](http://marine.copernicus.eu/web/69-interactive-catalogue.php?option=com_csw&view=details&product_id=SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001) and also [http://ghrsst-pp.metoffice.com/pages/latest\\_analysis/sst\\_monitor/ostia/anom\\_plot.html?i=34&j=2](http://ghrsst-pp.metoffice.com/pages/latest_analysis/sst_monitor/ostia/anom_plot.html?i=34&j=2) or <http://www.ospo.noaa.gov/Products/ocean/sst/anomaly/index.html> which contain the relevant data on global SST anomalies. The SST is produced by subtracting the long-term mean SST (for the duration and location of interest in a given time) from the current value. A positive anomaly denotes that the current SST is warmer than average, while a negative anomaly denotes it is cooler than average. The spatial resolution is usually 0.5-degree (50-km), and the data and images are regularly updated up to two times a week. The required location, time and duration can then be computed from the data. This can be done by downloading the SST trends for the required location and the duration, plotting the coordinates and anomalies for the required location; from which graphical and imagery output required for all seasons can be accessed and interpreted. Figure x illustrates how the JDA or any potential user can implement the indicator for the JDZ or any given area of interest respectively:

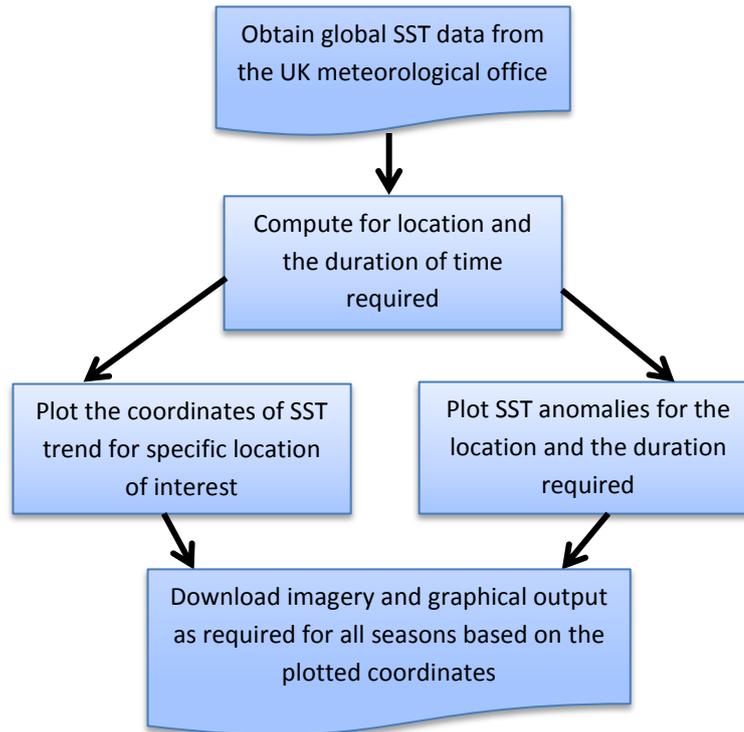


Figure 8.0: Illustration of sea surface temperature computation (Source: Author's own)

### 8.2.2 The JDA scoring of and weights assignment to the chosen indicators

The JDA-chosen indicators were then assigned a variety of weights and scores against each of the selection in order to highlight the significance attached to each of the choices (Table 7.12 of Section 7.8). All weights and scores were assigned based on the JDA's operational and management objectives as required in the development of indicators (Rice & Rochet, 2005; Rochet & Rice, 2005).

From the feedback and comments primary productivity was assigned 'high' weight and given a score of four while the sea surface temperature was also assigned a 'high' weight and a score of four despite its seeming impracticality (Table 7.12 of Section 7.8). This is explained in detail in Section 8.2.1. This is as a result of the remote location of the JDZ which made the JDA to view the utilisation of the indicator as impracticable. Similarly, oceanographic front was also assigned a 'high' weight and a score of four depicting its strong acceptability. Others are mercury contamination, plastic resin pellets, nutrients indicator; negative trends in Dissolved Oxygen Concentration, Harmful Algal Blooms and marginal economic value; which

were all assigned a 'high' weight and a score of four each. However, shipping density was assigned a 'moderate' weight and a score of three while sediment discharge and seamounts at risk were each assigned a 'fair' weight with corresponding score of two.

Other indicators not mentioned were neither assigned weights nor scored and represented the ones not chosen by the JDA in line with their current operational and management objectives as obtained from their feedback and comments (Tables 7.12 and 7.13 of Section 7.8). Details from the comments further indicated that the choices made, weights assigned and scores given were all based on the prevailing and envisaged position of their operational and management objectives as reflected in the current management arrangements for the marine fishery resources of the JDZ. This further confirmed the absence of a formal indicator-based sustainability assessment as reported in sections 6.7 to 6.7.3.

### **8.2.3 The JDA compliance in terms of the choices**

The concept of indicator-based LME assessments has been recognised globally as one which incorporates the principles of an ecosystem based management approach for the study of marine ecosystems goods and services and in support of adaptive management (Alexander, 1983; Sherman, 2005; Sherman et al., 2009; Sherman, 2014). It is worthy to note that the LME components and their methodologies (IOC-UNESCO, 2011) were originally designed to cater for areas of LME scale-usually 200,000 square kilometres or larger (Sherman, 2014). However, the developers of the methodology (IOC-UNESCO, 2011) recognised the dearth of specific indicators for 'transboundary hotspots' such as the research area popularly termed as areas of sub-LME scale and earmarked its development for the future as (Sections 2.14 and 3.9).

One of the main reasons the TWAP-LME indicators are being evaluated for their possible application to the JDZ is because they have been originally developed for transboundary water courses of LME scale among others (IOC-UNESCO, 2011). They are also being evaluated in the absence of specific sets of indicators for areas of sub-LME scale.

From the survey analysis it emerged that some of the stakeholders such as the NIOMR and the Fisheries Department of Nigeria have some limited knowledge and employment of indicators. However, their inputs/efforts were hampered as a result of the absence of clear jurisdiction in terms of utilisation of such indicators as (Sections 6.3.5 and 6.7.3) as well as absence of clear methodologies for robust assessments.

From the information contained in the feedback and comments returned by the JDA and their classifications of the TWAP-LME indicators (Tables 7.10 and 7.11 of Section 7.8), the JDA categorised the indicators into environmental and bio economic indicators. This is in line with both their perceptions of the indicators and their operational and management objectives based on the current arrangements they have in place for the management and assessment of the JDZ marine fishery resources.

The concept of indicator-based LME assessments have been employed in some parts of Africa, United States, Asia, Latin America and Eastern Europe (Sherman, 2014) on a large marine ecosystem scale through the support of GEF. However, it is worthy to note that this is the first study that attempts to examine the feasibility of applying TWAP-LME indicators for the assessment of a transboundary shared marine resource situated in an area of sub-LME scale within an identified LME; the GCLME. This has been undertaken to generate key lessons and critical insights that will contribute towards the development of specific sub-LME indicators. Additionally, it will strengthen the potential marine fishery regime of such areas. It is also to be noted that the compliance levels to be depicted for the situation of the JDZ fisheries are based on the potentialities of employing each of the indicators (Section 8.2.1) and may not necessarily be currently employed or in use.

Consequently, comparison of the compliance levels between the TWAP-LME indicators application are based on the existing literature (Sherman, et al., 2009; Sherman, 2014). This is evidenced in already reported LMEs in Africa (McGlade et al., 2002), North Sea (Sherman et al., 2009b), United States and Eastern Europe (Sherman, 2014) and the level of their application to the JDZ marine fishery

resources based on the initial survey analysis and the feedback and comments obtained from the JDA.

Compliance levels are hereby denoted in Table 8.0 by four categories, namely; zero, potential, partial and full implementations depicting various stages of the deployment of the indicators in the JDZ and the other locations mentioned (Table 8.0).

Table 8.0: JDZ TWAP-LME indicators compliance comparison with global regions  
(Source: Author's own)

TWAP-LME Indicators	Compliance Levels	
	At The JDZ	At Elsewhere
Primary Productivity	Partial	Full
Sea Surface Temperature	Potential	Full
Oceanographic Fronts	Partial	Full
Reported Landings	Potential	Full
Value of Reported Landings	Potential	Full
MTI & FIB	Potential	Partial
Ecological Footprints of Fisheries	Potential	Partial
Stock Status Plots	Potential	Full
Fishing Efforts	Potential	Partial
Projected Catch Potential	Potential	Zero
LME carrying capacity in relation to MSY	Potential	Partial
Mercury Contamination	Partial	Partial
Plastic Resin Pellets	Zero	Zero
Nutrients Indicator	Potential	Potential
Negative Trends in Dissolved Oxygen Concentration	Partial	Partial
Shipping Density	Potential	Potential
Harmful Algal Blooms (HABs)	Potential	Partial
Freshwater Discharge	Zero	Potential
Sediment Discharge	Potential	Potential
Seamounts at Risk	Potential	Partial
Change in Protected Area Coverage	Zero	Partial
Change in extent of Mangrove Habitat	Zero	Partial
GDP Fisheries	Potential	Full
Human Development Index (HDI)	Zero	Full
Deaths/100000 caused by climatic Disasters	Zero	Full
Marginal Economic Value (MEV)	Potential	Partial

### **8.3 Status of the TWAP-LME indicator-based assessments to the JDZ fisheries based on the feedback and comments from the JDA**

It is evident from the feedback and comments returned by the JDA that it is in most areas of indicators' compliance sub-optimal. It is equally important to note that even in areas with presumably complete TWAP-LME applications, not all the indicators are currently fully implemented (Table 8.0 of Section 8.2.3).

Although the JDA is yet to have a fully developed marine fishery regime in operation as explained in several places in this thesis, the areas they may be said to be optimal in terms of the indicators' compliance are in the categories of indicators they believe they currently possess information/data on that would lead to their potential implementation. As such the status of the application of the TWAP-LME indicators from the current JDZ fisheries management arrangements will be discussed in Sections 8.4 to 8.8.4. It is also with a view to developing a robust and sustainable fisheries sub-sector as revealed from the survey as well as the returned feedback and comments covering letter.

## **8.4 The productivity module components**

### **8.4.1 Primary productivity**

Information from Table 8.0 of Section 8.2.3 showed that the primary productivity indicator is currently partially applied at the JDZ because they believe the quantitative data obtained from the bottom fauna, selected physical and chemical compounds survey in conjunction with the satellite data from the NOAA can reveal the JDZ's primary production levels. In other regions however, the indicator has been shown to be fully implemented as highlighted in the comparison table and detailed in Section 3.7. As such, the application of primary productivity indicator may be said to be optimal while it is equally among the already chosen as one of the candidate indicators by the JDA in their feedback and comments based on their current management arrangements in place for sustainable JDZ fisheries assessment.

### **8.4.2 Sea surface temperature**

The sea surface temperature indicator is shown to be currently not applied to the JDZ but with strong potentials of being developed in spite of it being termed as impractical as (Section 8.2.2), (Table 7.13 of Section 7.8) and (Table 8.0 of Section 8.2.3) (comparison table) based on the feedback and comments from the JDA. But sea surface temperature as an indicator is currently being applied fully in other LMEs as shown in Table 8.0 and detailed in Sections 3.6.4 to 3.7. As such, the application of sea surface temperature as an indicator to the JDZ though chosen by the JDA in their feedback may be said to sub-optimal based on the current management arrangements in place for the sustainable JDZ marine fisheries assessment as revealed from the returned feedback and comments.

### **8.4.3 Oceanographic fronts**

From the feedback and comments returned by the JDA; oceanographic front indicator is shown to be currently partially applied to the JDZ (Table 8.0 of Section 8.2.3). This is based on the recent bottom fauna, selected physical and chemical compounds survey they conducted which possesses the potentials to reveal capabilities for climate change monitoring and predictions. Oceanographic fronts are however currently applied to a range of other LMEs such as Yellow Sea, North Sea, South China Sea where they present marine physical-biological correlations in association with chlorophyll and SST trends once digitized (Sherman & Hempel, 2008; Belkin, 2009; Belkin & O'Reilly, 2009; IOC-UNESCO, 2011; Sherman, 2014). Their application to the JDZ as an indicator while being chosen from among the list of candidate TWAP-LME indicators can be said to be currently sub-optimal based on the current management arrangements in place for the sustainable JDZ marine fisheries assessment as revealed from the feedback and comments.

## **8.5 The fish and fishery module components**

### **8.5.1 Reported landings**

Details from the feedback and comments returned by the JDA on the 'reported landings' as an indicator revealed that it is currently not applied to the JDZ though with a strong potential as one of the JDA-termed economic TWAP-LME indicators as (Table 7.11 of Section 7.8 and Table 8.0 of Section 8.2.3). Its non-application

currently was said to be due to the non-commencement of commercial fishing activities officially by the JDA. It has however been termed as an indicator that possessed a strong potential when a substantive fishery regime comes into place. As such, its application to the JDZ fisheries currently can be termed as sub-optimal and was correspondingly not chosen from the list of candidate TWAP-LME indicators but featured for its potential usefulness as (Table 8.0 of Section 8.2.3) based on the current management arrangements in place for sustainable JDZ marine fisheries assessment.

### **8.5.2 Value of reported landings**

The 'value of reported landing' is one of the indicators that were termed by the JDA as 'economic TWAP-LME indicators'. Its non-implementation was attributed to the non-commencement of commercial fishing and fishing related activities within the JDZ. It was however featured as an indicator with a strong potential as (Table 8.0 of Section 8.2.3) and expected to be fully implemented upon the commencement of commercial fishing activities when a substantive fishery is fully established. The same indicator is however currently implemented fully in other reported LMEs as (Table 8.0). Its application to the JDZ fisheries currently may be termed as sub-optimal and was equally not among the JDA-chosen indicators based on their current arrangements for the sustainable marine fishery resources management of the JDZ. This was revealed from the returned feedback and comments; which divulged the current management arrangements in place for sustainable JDZ marine fishery assessment.

### **8.5.3 Marine trophic index (MTI) and Fish in balance index (FIB)**

Information obtained based on the feedback and comments from the JDA on the 'MTI & FIB' as an indicator revealed that it is currently not being applied and is classified as one of the TWAP-LME economic indicators. Their justification for the non-application has also been attributed to the non-commencement of the commercial fishing activities under a substantive fishery regime in the JDZ. This indicator is also not fully implemented currently even in other LMEs but only partially implemented (Table 8.0). This is due to issues of integrity arising from differences in species composition as well as fragmentation among the varying data

sets capable of affecting the weighting system as (Section 3.6.5.3). Its application to the JDZ fisheries management in line with their current management arrangements and stage of their commercial fishing activities and also to other reported LMEs can be said to be sub-optimal albeit with a potential for future assessments.

#### **8.5.4 Ecological footprints of fisheries**

The status of the 'ecological footprints of fisheries' as an indicator from the returned feedback revealed that it is equally not implemented but recognised as one with a strong potential and was categorised under what the JDA termed as 'TWAP-LME bio-economic indicators'. Among the reasons put forward for its non-implementation is the absence of a viable monitoring capacity as a result of the non-commencement of full commercial operations as well as general neglect of the marine living resources of the JDZ as (Section 6.3.4). This indicator is only partially implemented even in already reported LMEs despite their reliable fisheries data (Table 8.0 of Section 8.2.3) as a result of issues of reliability occasioned by variability of species and composition in a particular area as well as issues of migratory stocks. It is expected to be particularly more difficult for African LMEs with their data-poor marine ecosystems. As such, its application to the JDZ fisheries based on the current JDA's marine fishery management arrangements can be said to be sub-optimal and was correspondingly not among the chosen indicators but earmarked for its potentials in future.

#### **8.5.5 Stock status plots**

The 'stock status plots' indicator is currently not applied to the JDZ fisheries by the JDA based on their feedback and comments and is classified among the 'bio-economic TWAP-LME indicators'. Non-implementation was also attributed to the non-commencement of commercial fishing operations. It is however recognised as one of the indicators with a strong potential for application to the JDZ fishery due to its ability to determine stock exploitation status that may lead to achieving sustainable yields (Section 3.6.5.5). It is also being fully implemented in other reported LMEs (Table 8.0 of Section 8.2.3). Its current application to the JDZ fisheries may be termed as sub-optimal based on the JDA's current marine fishery management arrangements and the level of their operational objectives.

### **8.5.6 Fishing efforts**

The 'fishing efforts' indicator is one of the JDA-termed economic indicators and is currently not being applied to the JDZ fisheries but recognised as one with a strong potential upon the commencement of full commercial activities within the JDZ fisheries sub-sector (Table 8.0 of Section 8.2.3). It is equally not fully implemented even in other already reported LMEs from across the globe as also depicted in (Table 8.0). This is because it is expressed as global kilowatts days inputted by continents, by individual countries, by vessel tonnage class, by vessel and by gear types. Developing a global, comprehensive and explicitly spatial database for correctly computing this indicator is cumbersome but continuing as already (Section 3.6.5.6). So, based on the feedback and comments from the JDA and in line with their current marine fishery management arrangements for the JDZ; the current status of 'fishing effort' indicator can be said to be sub-optimal and not in application to the management and assessment of the JDZ fisheries.

### **8.5.7 Projected catch potential**

Information obtained in the feedback and comments from the JDA indicated that 'projected catch potential' indicator is currently not applied to the JDZ fisheries management but possesses potential for use in the future. Its non-inclusion was also attributed to the non-commencement of commercial fisheries within the JDZ and was categorised under the JDA-termed 'economic indicators'. It is also currently not employed in other reported LMEs from across the globe (Table 8.0 of Section 8.2.3). Although relevant, in that it has the ability to decipher variation or change in maximum catch potential capable of affecting global food security in addition to being equally relevant in projecting MDGs targets. While it is believed to possess the ability to be structured to suit conditions for global LMEs (Sherman, 2006; Sherman & Hempel, 2008; Cheung et al, 2009; Sherman et al, 2009; Sherman et al, 2009b), it is yet to be tested anywhere else (Cheung et al, 2009; IOC-UNESCO, 2011) (Section 3.6.5.7). As such, its status in terms of application to the JDZ marine fishery management can equally said to be sub-optimal based on the current management arrangements in place by the JDA for the sustainable JDZ marine fishery management.

### **8.5.8 LME carrying capacity in relation to Maximum Sustainable Yield**

The 'LME carrying capacity in relation to MSY' indicator is among the JDA-termed 'bio-economic indicators' although currently not in use but featured as a very important indicator with a strong potential when full commercial fishing activities commence for the JDZ (Table 8.0 of Section 8.2.3). Its current status of deployment in other reported LMEs from across the globe indicated it is only being partially implemented despite its ability to provide broad perspective of LME ecosystems trends and capability to observe changes under varying environmental conditions as ecosystems' processes and structures change. This is due to its computational requirements; which involve approximating fish biomass estimates in LMEs through the use of Ecopath with Ecosim (EwE) modelling approach-capacity of which is still being developed-and the concept of ecosystem carrying capacity (Christensen et al, 2009; IOC-UNESCO, 2011). Also, it has only been tested in the Yellow Sea so far (Sherman, 2014). So, its current status of application to the JDZ marine fishery resources management may be said to be sub-optimal partly due to existing management arrangements in place by the JDA for the sustainable JDZ marine fisheries management and partly due to its current deployment levels even in the already reported LMEs (Section 3.6.5.8).

## **8.6 Pollution and ecosystems health components**

### **8.6.1 Mercury contamination**

'Mercury contamination' as an indicator is used to determine negative trends in human health in relation to the marine environment. It has the ability to quantify long range atmospheric transport and persistence on the environment once induced anthropogenically. It is one of the pollution and ecosystems health module TWAP-LME indicators and one of the JDA termed 'environmental indicators'. It is also deemed to be partially applied currently to the JDZ fishery in that the JDA believed the quantitative data obtained from the bottom fauna, selected physical and chemical compounds survey conducted in conjunction with the Norwegian Institute of Marine Research is capable of revealing the extent of mercury contamination levels around the JDZ. As such, its implementation currently to the

JDZ marine fishery assessment despite being chosen as an indicator can be said to be partial (Table 7.10 of Section 7.8) based on the position of the JDA as obtained from their feedback and comments on the current management arrangements for the sustainable JDZ marine fishery management. It is equally found to be only partially applied in other reported LMEs (Table 8.0 of Section 8.2.3) partly because reliable data and practice on this indicator is only currently available in Europe, North America and Japan, and partly because there is still no known application to any of the African LMEs (Section 3.6.6.1).

### **8.6.2 Plastic resin pellets**

Information and feedback from the JDA on the implementation of ‘plastic resin pellets’ as an indicator revealed that it is currently not applied to the JDZ fisheries as (Table 8.0 of Section 8.2.3). It is, however, expected to be used upon commencement of full fishing activities. It is one of the pollution and ecosystems health module TWAP-LME indicators and one of the JDA-termed ‘environmental indicators’. It is not assumed to hold strong potential however as a result of its data requirements. These are dependent upon the collection of pellets from adjoining beaches via a network of volunteers for analysis in a single laboratory situated in Japan for analysis (Ogata et al, 2009; Smedes et al, 2009; Lohmann & Muir, 2010; IOC-UNESCO, 2011) and as (Section 3.6.6.2). Although chosen by the JDA (Table 7.12 of Section 7.8) the indicator may be difficult to compute due to the reasons mentioned and the remoteness of the JDZ location to either of the two countries’ beaches. The indicator is also currently not being implemented even across other reported LMEs (Table 8.0 of Section 8.2.3). Consequently, its application to the JDZ fisheries can be said to be sub-optimal based on the current levels of marine fisheries management arrangements in place for the JDZ fisheries.

### **8.6.3 Nutrients indicator**

The ‘nutrients’ indicator is one of the pollution and ecosystems health module TWAP-LME indicators and one of the JDA-termed ‘environmental indicators’ which is relevant in aggregating Dissolved Inorganic Nitrogen (DIN) load per LME by computing spatially-explicit global watershed models in relation to human natural processes. Its importance is in the fact that LMEs have been known to be over

enriched in terms of nutrient loading (Seitzinger et al, 2005; IOC-UNESCO, 2011) (Section 3.6.6.3) and with a growing number of frequent occurrences (Sherman, 2014). It is currently not employed by the JDA based on the returned feedback and comments but found to possess some potential (Table 8.0 of Section 8.2.3). However, the JDA believe it may be computed from the quantitative data obtained from the bottom fauna, selected physical and chemical compounds survey conducted. It was correspondingly among the indicators they chose as depicted in Table 7.12 of Section 7.8 based on its strong potential. It is also found to be not currently applied to other reported LMEs (Table 8.0 of Section 8.2.3) as a result of fragmented data sets in forms of maps and visuals that are yet to be compiled and tested for reliability and credibility. However, it is recognised for its potential and expected to be fully developed for FSP of the TWAP-LME GEF funded projects in the future (IOC-UNESCO, 2011) (Section 3.6.6.3).

#### **8.6.4 Negative trends in Dissolved Oxygen Concentration**

The 'negative trend in dissolved oxygen concentration' indicator is one of the pollution and ecosystems health module TWAP-LME indicators and categorised by the JDA as one of the 'environmental indicators'. It is used to identify linkages to hypoxic zones occasioned by eutrophication on the continental shelf and is computed as a proportion of all available time-series data sets and measurements that portray any negative trend in Dissolved Oxygen (DO) which greatly affects marine fisheries community. While it is among the chosen indicators by the JDA as (Table 7.10 of Section 7.8), data for its computation for the JDZ marine fishery community is expected to be generated upon analysing the bottom fauna, selected physical and chemical compounds survey conducted in conjunction with the Norwegian Institute of Marine Research. That is why the JDA recognised it one indicator with a strong potential upon the full commencement of commercial fishing activities based on the returned feedback and comments (Table 7.12 of Section 7.8 and Appendix Seven). Information from other reported LMEs from around the globe indicated only partial application as data for the indicator is only available for some parts of Europe, North America and a few Asian LMEs (Gilbert et al, 2010) as (Section 3.6.6.4).

### **8.6.5 Shipping density**

The 'shipping density' indicator is also one of the pollution and ecosystems health module TWAP-LME indicators and classified by the JDA as one of the 'environmental indicators'. It is employed to determine shipping traffic as one of the dominant source of distant anthropogenic sound capable of impacting negatively on the marine life within the marine ecosystems. It is computed via the estimation of ship-sourced inputs of contaminants such as tributyltin TBT, ballast water discharges and other hydrocarbons as a function of ship traffic. This is very significant for the JDZ. Being a zone of deep offshore oil exploration activities and was correspondingly chosen by the JDA (Table 7.10 of Section 7.8) as an indicator with a strong potential as (Table 8.0 of Section 8.2.3) upon the commencement of full commercial activities. While fragmented data sets exist in a number of institutions including the VOS programme of the NOAA, GESAMP and IMO (IOC-UNESCO, 2011) there is the need to further develop the indicator with a view to harmonising the varying volumes of data from all identified sources to provide a spatially referenced data on ship size, ship type, shipping traffic and flag state both for record-keeping and potential prosecution of polluters. Information obtained on other reported LMEs from the literature indicated that it is currently only partially applied in Europe and North America as a result of the fragmentation of the existing data sets as (Section 3.6.6.5). As such, its application to the JDZ marine fishery management and assessment can be said to be sub-optimal based on the current management arrangements put in place by the JDA for the sustainable JDZ marine fishery management.

### **8.6.6 Harmful Algal Blooms (HABs)**

The 'harmful algal bloom' indicator; which is used to determine contamination of sea food with toxins that alters the state of ecosystems' health and services in addition to endangering the livelihood of the marine ecosystems' services is one of the pollution and ecosystems health module of the TWAP-LME indicators. It is also among the JDA-classified 'environmental indicators' as (Table 7.10 of Section 7.8). Information from the feedback and comments from the JDA indicated that it is recognised as an indicator with a strong potential (Table 8.0 of Section 8.2.3) upon the commencement full commercial fishing activities and its data expected to

emanate from the quantitative data obtained during the bottom fauna, selected chemical and physical compounds survey conducted in conjunction with the Norwegian Institute of Marine Research. It is as a result of this that the JDA also chose it among the candidate indicators based on the returned feedback and comments (Table 7.12 of Section 7.8). It is computed via the compilation of various HABs data from a variety of sources such as the NOAA Harmful Algal Blooms Observing System (HABSOS) (IOC-UNESCO, 2011) and the review of global map of hypoxia events (Selman, Greenhalgh, Diaz & Sugg, 2008) capable of identifying cataloguing systems areas susceptible to eutrophication within a marine ecosystem as (Section 3.6.6.6). Information on its application to other reported LMEs from around the globe indicated that it is only partially applied only in data-rich regions such as the Gulf of Mexico and North America due to fragmentation of the existing data sets as well as concerns for issues of integrity and potential computational disparities. Consequently, the implementation of the indicator to the JDZ marine fishery assessment can be said to sub-optimal based on the returned feedback and comments from the JDA on the current marine fishery management arrangements for the JDZ fisheries.

#### **8.6.7 Freshwater discharge**

The 'freshwater discharge' indicator is one of the pollution and ecosystems health module TWAP-LME indicators but was not selected by the JDA for potential employment due to its recognition as highly irrelevant to their situation (Tables 7.12 and 7.13 of Section 7.8). And it was equally not classified into any category based on their classifications (Tables 7.10 and 7.11 of Section 7.8) denoting their categorisations of the TWAP-LME indicators. The reason for the non-categorisation and the non-selection is because of the remoteness of the JDZ location; which is located approximately between 0° 1' 3" and 3° North (See Figure 5.1 in Section 5.2). The indicator is used to determine the impact of human activity and climate change variability on freshwater input to coastal and marine habitats. It is computed via mapping the spatially-explicit global watershed model (NEWS) similar to the 'nutrients indicator'. It is equally currently dependent on fragmented data sets and as such is not in application anywhere else (Seitzinger et al, 2005; IOC-UNESCO)

even among the reported LMEs from around the globe (Section 3.6.6.7). As such, the indicator is equally not being applied currently to the JDZ and does not possess any potential for future inclusion (Table 8.0 of Section 8.2.3) and is therefore considered sub-optimal based on the current management arrangements for the sustainable JDZ marine fishery management.

#### **8.6.8 Sediment discharge**

The 'sediment discharge' indicator is among the JDA-termed 'environmental indicators' and one of the pollution and ecosystems health module TWAP-LME indicators. Its use is in the determination of sediment smothering on marine habitats such as coral reefs and sea grasses. It is computed via mapping spatially-explicit global watershed model similar to the nutrients indicator and the freshwater discharge indicator. It is particularly relevant in that some human interference such as water diversions and dam constructions significantly alter sediment loading to coastal and marine waters with its attendant negative impacts on the marine ecosystems and their services (Section 3.6.6.8). It is however among the chosen indicators by the JDA but with a low score of two and an assigned weight of 'fair' (Table 7.12 of Section 7.8) for its likely potential due to the amount of activities that take place around the GCLME coastal environments. Similarly, information on its implementation in other reported LMEs indicated it is yet to be applied (Section 3.6.6.8) and (Table 8.0 of Section 8.2.3) but possesses some potential and intended for inclusion in the FSP in future. Consequently, its current application to the JDZ fishery assessment can be said to sub-optimal based on the current management arrangements in place.

#### **8.6.9 Seamounts at risk**

The 'Seamounts at risk' indicator is one of the pollution and ecosystems health module TWAP-LME and among the JDA-classified 'environmental indicators'. It is computed via documenting species located in cold seep locations and hydrothermal vents in hydrothermally active and non-active seamounts. They are relevant in manifesting species conditions located in those seamounts and those targeted by destructive fishing practices such as bottom trawling and improper gear practices (Section 3.6.6.9). Although, it is only partially implemented even among some

reported LMEs from around the world (Table 8.0 of Section 8.2.3) it is among the chosen indicators by the JDA from their feedback and comments albeit with a low score of two and a moderately assigned weight of 'fair' and one with some potential as shown in Table 7.12 of Section 7.8. It is also believed by the JDA to be among the set of indicators whose data may emerge from the recently conducted bottom fauna, selected physical and chemical compounds survey in 2012. As such, its current status in terms of implementation for the JDZ fishery can be said to be sub-optimal based on the current management arrangement in place for the sustainable management of the JDZ fisheries.

#### **8.6.10 Change in protected area coverage**

The 'change in protected area coverage' indicator is an indicator among the pollution and ecosystems health TWAP-LME indicators and one of the indicators not selected by the JDA as a result of non-applicability considering the location of the JDZ; an area deep in the Atlantic located approximately between 0° 1' 3" and 3° North. As such, it was not selected among the chosen indicators and was equally scored zero and deemed irrelevant and impracticable to the JDZ marine fishery assessments. It is computed via mapping of globally spatial data sets for marine terrestrial protected areas from national governments and recognised NGOs, which are then uploaded onto World Database on Protected Areas (WDPA) for processing and subsequent release online by the UNEP-WCMC. So far, it has only been applied to a select few locations around Europe and North America among the reported LMEs. Even in those some are faced with issues of integrity as a result of integrity of the data; being from a variety of multiple sources with slim verifiability (Section 3.6.6.10). Consequently, its applicability to the JDZ marine fishery is considered sub-optimal, impractical and irrelevant based on these reasons and the returned feedback and comments from the JDA. This is in addition to the remoteness of the JDZ location and the current arrangements in place for the sustainable JDZ marine fishery management.

### **8.6.11 Change in extent of mangrove habitat**

The 'change in extent of mangrove habitat' indicator is one of the pollution and ecosystems health module TWAP-LME indicators and one of those rejected by the JDA in their selection as in Table 7.12 of Section 7.8. It is used in examining mangrove cover; seen as key to biodiversity target's success since mangroves have been found to be under threat from anthropogenic climate change and its great value is in maintaining ecosystems' services (IOC-UNESCO, 2011). It is computed via computing varying topographical layers to determine extent of changes to marine habitats (Section 3.6.6.11). It is currently not in application to the JDZ fisheries (Table 8.0 of Section 8.2.3) due to the remoteness of the JDZ location. It is for this remoteness and the distance from any of the two countries' mangroves that it was not selected and scored zero, deemed irrelevant and impracticable by the JDA for the JDZ marine fishery assessments. Although a global layer of data exists, but for very limited locations, confined to Europe and North America and as such is only partially being applied among the reported LMEs (Table 8.0 of Section 8.2.3). The current status of its implementation for the JDZ marine fishery assessments and management can be said to be sub-optimal, impractical and irrelevant based on the returned feedback and comments from the JDA on their level of management arrangements in place for the sustainable JDZ fisheries.

## **8.7 The socioeconomic module components**

### **8.7.1 GDP fisheries**

The 'GDP fisheries' indicator is one of the socio-economic module TWAP-LME indicators and among the JDA-termed bio-economic indicators (Table 7.11 of Section 7.8). It is employed in measuring reliance or dependence on fisheries provisioning services among ecosystem services. It is used in identifying the value of fishery output nominally achievable from fisheries per any given or for any two nations in shared nation in a shared fishery resource arrangement. It was however not chosen by the JDA (Table 7.12 and 7.13 of Section 7.8) but recognised as one indicator with a strong potential when commercial fishing activities commence for the JDZ fisheries (Table 8.0 of Section 8.2.3). It is an indicator that is however being fully applied in many reported LMEs (IOC-UNESCO, 2011), (Section 3.6.7.1) whose

potential is recognised for the JDZ fisheries. As such, its application to the JDZ fisheries can be said to be sub-optimal based on the current arrangements in place for the sustainable JDZ fisheries management as revealed in the feedback and comments returned by the JDA.

### **8.7.2 Human Development Index (HDI)**

The 'human development index' indicator is among the indicators rejected by the JDA and is one of the socio-economic module TWAP-LME indicators. It was not selected due to non-relevance and non-applicability in addition to the location of the JDZ (Tables 7.12 and 7.13 of Section 7.8). This indicator is used in the identification of livelihood levels derivable from fishery ecosystem provisioning services and is calculated as a composite of life expectancy at birth, adult literacy rate and per capita GDP. While this indicator is currently not in application for the JDZ fisheries due to non-commencement of commercial fishing activities, it is recognised as one with a strong potential when the fishery regime eventually commences (Table 8.0 of Section 8.2.3). It is however found to be currently fully in use in most of the reported LMEs around the globe as shown in the same table. In line with the preceding assertions, it can be said that the current status of the indicator's application to the JDZ fisheries is sub-optimal based on the feedback and comments returned by the JDA on the current management arrangements in place for the sustainable JDZ fishery management and assessment.

### **8.7.3 Deaths per 100000 caused by climatic disasters**

The 'deaths/100000 caused by climatic disasters' indicator is one of the socio-economic module TWAP-LME indicators and among the ones not chosen, selected or assigned any score by the JDA (Tables 7.10, 7.11, 7.12 and 7.13 of Section 7.8) due to the JDZ's location. It is used in indicating how naturally-induced disasters affect humans based on natural occurrences. Its greatest value is in examining climate change impacts on humans and ecosystems (IOC-UNESCO, 2011). Data is usually available from climate risk index for any given nation, censuses, FAO and can be collected nationally from individual nations' population agencies (UNEP, 2011). Although, it is considered irrelevant to the JDZ based on the location of the JDZ, it is fully implemented in almost all the reported LMEs most especially in

relation to the LME's contributions to the adjacent coastal communities (Table 8.0 of Section 8.2.3) and (Section 3.6.7.3). So the status of indicator's applicability to the JDZ fisheries can be said to be sub-optimal based on the feedback and comments returned by the JDA on the current management arrangements in place for the sustainable JDZ fisheries assessments and management.

#### **8.7.4 Marginal economic value**

The 'marginal economic value' indicator is one of the socio-economic module TWAP-LME indicators and among the JDA-termed 'environmental indicators as (Table 7.10 of Section 7.8). It is used to identify both positive and negative impacts on the ecosystem services (Section 3.6.7.4). It is recognised as a very valuable indicator for decision making because decisions usually involve incremental changes in ecosystem provisioning services (Barbier et al, 2009; IOC-UNESCO, 2011). It is computed as the additional value gained or lost by a change in provision of flow or in a level of stock. It is also chosen by the JDA as one with a strong potential (Table 8.0 of Section 8.2.3) upon the commencement of full commercial fishing activities. Although data exist currently for some developed nations; it is only being applied partially as a demonstration project even among the reported LMEs (Section 3.6.7.4). Consequently, the status of its implementation for the JDZ fisheries can be said to be sub-optimal based on the feedback and comments returned by the JDA on the current management arrangements in place for an indicator-based sustainable JDZ marine fishery assessment and management.

### **8.8 The governance module order of outcomes components**

The governance module, as mentioned in section 3.7.4 is based on four orders of outcomes which are enabling conditions, changed behaviour, attainment of LME goals and sustainable LME conditions and uses.

#### **8.8.1 Enabling conditions**

Results from the analysis as revealed from the main survey themes, namely; the management structure, management policies adopted for JDZ fisheries, nature of fishing within the JDZ, nature of IUU fishing around the JDZ and the level of awareness and or employment of indicators explicitly revealed clear fragmentations among institutions (Sections 6.3 to 6.75). This is in addition to the absence of

integration and synergy among various critical stakeholders (Sections 6.8 and 6.8.1). As such, enabling conditions may be said to be not in place within the current management arrangements in place for the sustainable JDZ marine fishery management and assessments (Sections 8.4 and 8.7).

### **8.8.2 Changed behaviour**

Although as has been reported in various sections in the thesis, notably (Sections 6.8 and 6.8.1); there is currently no substantive marine fishery regime currently in place for the JDZ marine fisheries management and assessment. There is evidence of changed behaviour from across a varied range of stakeholders as revealed during the survey. Some of these include some of the steps taken by critical stakeholders towards acknowledging the need for integration in addition actually designing a system of incorporating relevant stakeholders for partnerships in line with principles of ecosystem based fishery management practices. One example is the resolution of the JDA to focus on developing the marine fisheries by commencement of surveys (Section 6.3.4). Another is the JDA's plan to obtain permits from the two countries to put in place a unified licencing system in order to foreclose issues of migratory stocks (Section 6.3.5). This demonstrated a clearly improved behaviour compared to the earlier JDA's position on fishery licencing which may have contributed towards the delay in establishing the fishery regime.

### **8.8.3 Attainment of LME goals**

It has been made clear that attainment of LME goals may not have been completely achieved even in data-rich and more developed and reported LMEs. It is however, imperative to note that African LMEs such as the GCLME and Benguela Current Large Marine Ecosystem (BCLME) were among the first recipients of the GEF funding for the development of indicators as Sections 3.3 and 3.8.3). The GEF intervention led to provision of TDAs for African marine ecosystems though on a wider LME scales (Section 3.8.3) as against for areas of sub-LME scale such as the research area. This is unarguably due to the absence of specific sub-LME indicators for the assessment of areas of sub-LME scale (IOC-UNESCO, 2011). The LME goals for the JDZ are therefore expected to be attained when full commercial fishing

operations commence most especially with a changed behaviour among the critical stakeholders already assumed to be achieved (Section 8.8.2).

#### **8.8.4 Sustainable LME conditions and uses**

As the JDA is still at the stage of establishing its marine fishery regime, it may be pre-emptive to determine its current conditions and uses. While observed changed behaviour has been observed to be currently in place, the institutional frameworks necessary for the enabling conditions must be developed and functional before conditions and uses can be adequately assessed in terms of their sustainability. This order of outcome may have to be carried forward for future research where the applied indicators are to be measured for their efficiency upon the establishment of a substantive fishery regime likely to be developed in line with recommendations from this research.

#### **8.9 Prioritisation order for the implementation of indicators**

It should be noted that there is no single perfect definition of an indicator and that indicators must be tailored to their expected use (Cordar, 2011) as extensively reported in Sections 2.11 and 7.3 of this thesis. In implementing indicators, they can however be prioritised from their scientific (ideal indicator requirements) and policy (practical steps based on users' perception) perspectives. As such, in implementing indicators, it is important to consider their order of importance from the scientific and policy perspectives.

From the scientific point of view, there exist appropriate evaluation criteria which must be considered in the development and implementation of indicators. These are:

- data availability,
- practicality,
- cost-effectiveness,
- comprehensiveness,
- acceptability by stakeholders and

- robustness

They are supported by a number of scholars such as Garcia et al., (2003); Rice & Rochet, (2005); Lescrauwaet et al., (2006); Salas et al., (2006); Ukwe, Ibe & Sherman, (2006); Sherman et al., (2009) and Heink & Kowarik, (2010).

While detailed critical evaluations of these criteria have already been reported and extensively discussed in detail in Sections 7.3.1 to 7.3.6, it should be noted that individual stakeholder's prioritisation of indicators must be in accordance with their specific needs and management arrangements. This is because as noted earlier, the use and development of indicators must be tailored to their expected use (Cordar, 2011).

An example of how prioritisation order is implemented for the study area is reflected in Table 7.8 and Appendix Seven (the returned feedback from the JDA) based on the evaluation of the JDA's choices and in line with the principles of stakeholder engagement in the development of indicator respectively.

Similarly, from the political viewpoint, there exist eight practical steps of establishing an appropriate system of indicators to be adopted by any implementing organisation based on their management arrangements (Rice & Rochet, 2005; FAO, 2011). These are

- identification of the user groups along with their needs,
- developing a list of candidate indicators in line with set out objectives,
- assignment of weighting criteria to the candidate indicators,
- scoring of the indicators against the criteria,
- summarising the results based on two matrices of the weights and scores given,
- sufficient interactive consultations among users,

- selection of indicators with outstanding scores in line with social, economic and ecological objectives and finally
- reporting and presentation of methods consisting of all the steps taken in the selection.

A critical evaluation and detailed prioritisation of these steps have already been extensively discussed and reported in Section 7.6 and are for general application for all potential stakeholders/user groups aimed at establishing a good system of marine indicators. An example of how this prioritisation order was implemented for the study area is reflected in Table 7.9 and Appendix Seven (the returned feedback from the JDA) based on the evaluation of the JDA's choices and in line with the principles of stakeholder engagement in the development of indicators respectively.

### **8.10 A critique of prioritisation order for implementation of indicators**

While scientific evaluation criteria that must be considered in implementing indicators have been discussed in Sections 7.6 and 8.9, it is imperative to note that some of them may not be practically possible to achieve. Similarly, indicators deemed politically expedient may not be scientifically probable to employ. As such, a balance or a concession is required in order to prioritise such indicators for implementation.

This has been achieved in several ways including when an indicator that is considered important or relevant as a result of convenience or acceptability to the users, fails to withstand academic scrutiny in terms of robustness such as data availability. That indicator can prove very challenging or useless.

Under such a circumstance, scientific consideration should be prioritised as against stakeholders' convenience because failure to prioritise scientific requirements ultimately leads to uncertainties. This is especially so in the marine environment known for its complex interactions (Buuren et al., 2002; Beliaeff & Pelletier, 2011). This is because in some instances (especially in data poor fisheries such as the case study area), most of the reported indicators (as against the TWAP-LME indicators)

are seldom robust but are convenient to the stakeholders' current situation. These include those indicators generally reported by the consortium of JDZ users which are illustrated in Table 7.5 of Section 7.4. Similarly, in this specific case study and similar studies; it has been noted that the JDA currently does not deploy what it terms 'bio-economic indicators' as reported in Table 7.11 of Section 7.8 due to unavailability of data. This seeming inability thereby prompts issues of trust in fisheries data acquisition as reported by some scholars (Glenn et al., 2012).

Sufficient data for the majority of fisheries including those from advanced countries such as in Southern Europe (for example Greece, Croatia, Albania) may not be readily available or credible as asserted by Tzanatos et al., (2013) due to poor data. As such, a key approach that can be used to mitigate this problem is the reconstruction of such data in line with prevailing practices. These include among others, use of the very rich repository of the global fishery database which exists within the UBC Sea Around Us Project. This project contain the reconstructions for both the Guinea Current as well as the methods used and can be found on the UBC website via <http://www.seaaroundus.org/data/#/lme/28?chart=catch-chart&dimension=taxon&measure=tonnage&limit=10> and <http://www.seaaroundus.org/catch-reconstruction-and-allocation-methods/> respectively. The methods can be applied to estimating data for a complex ecosystem such as the JDZ upon commencement of commercial fishing operations. However, the issue with such reconstructions is that they rely almost entirely on projections based on long-held data or viewpoints (Sumaila, 2007). This is because old data or viewpoints can be subject to significant revision, if politically or economically expedient, especially when dealing with a complex and dynamic ecosystem such as the marine environment. As such this can affect both the data and the method used in its compilation, thereby bringing the issue of its credibility into question. In this case, in order to eliminate or reduce to the barest minimum the issues of reliability or credibility, it is suggested that individual stakeholders' data for validating the reconstruction should be harmonised or, where economically viable, funds should be found for fresh acquisition of new data which is scientifically robust.

### 8.11 Summary

Chapter Eight discussed and integrated the feedback and comments returned by the JDA which highlighted their position on the current level of their employment of each of the indicators. It also dwelt on their choices, rationale and justification behind the choices and the assignment of scores and weights given to each of the proposed TWAP-LME candidate indicators in line with the requirements of indicator development.

The choice based on the ideal indicator requirements was equally evaluated which in turn revealed the JDA's current management arrangements in place for the sustainable JDZ marine fishery assessment and management from the feedback and comments as well. Also, the optimality and sub-optimality of each of the indicators deployment for the JDZ fisheries was established based on the JDA's position in terms of the current arrangements in place from the choices contained in the feedback and comments. This was undertaken based on divulging each indicator's current status of deployment by the JDA for the JDZ marine fishery assessment.

Chapter Nine will conclude the research, draw recommendations based on the whole analysis as well as the integrated feedback and comments returned by the JDA-the main stakeholders-in addition to highlighting the implications for further research based on the conclusions of this research.

## **Chapter Nine: Conclusions**

### **9.1 Introduction**

This chapter will present a synopsis of the preceding chapters and conclude the research by highlighting the deductions obtained from the analyses based on the data collected and the feedback and comments returned by the JDA to draw conclusions capable of justifying the objectives. It will also provide recommendations that are to be adopted or used to improve the JDZ marine fishery sustainability through an indicator-based marine fishery assessment and management. This will be in addition to justifying the recommendations and highlighting the implications for further research.

### **9.2 Main concluding statement**

The main issue of concern to the research has been to appraise the viability and effectiveness of implementing the 2011 published Transboundary Waters Assessment Programme-Large Marine Ecosystem (TWAP-LME) indicators to the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ). It was undertaken given the uniqueness of the JDZ (an area of sub-LME scale) amidst persistent Illegal, Unreported and Unregulated (IUU) fishing prevailing around the area. A total of fifteen institutional stakeholders were identified from across four different countries due to their roles and relevance. These include; management of the resource, fisheries management, maritime boundaries management, fisheries research, maritime security, marine ecosystems research, diplomacy, marine pollution and independent stakeholders.

The research explored some crucial elements in the evolution, development and deployment of indicators for marine fishery assessment. It most particularly chronicled the main resource managers'

- management structure,
- the management policies adopted for the JDZ fisheries,
- nature of fishing within the JDZ,
- nature of IUU fishing around the JDZ as well as
- The level of awareness and employment of indicators to the JDZ.

In evaluating these elements, the research has facilitated the emergence of a status situation on those them from among the range of the identified stakeholders that are directly and indirectly related to the JDZ marine fishery assessment and management. This is in addition to identifying areas of optimality and sub-optimality in terms of the current levels of TWAP-LME indicator-based marine fishery management arrangements in place for the sustainable JDZ marine fishery assessment and management.

Part one provided the introductory structure of the research, which covered the conceptual and practical bases of marine resource management. Chapter one set the study perspective by introducing the research area, the rationale behind the study, methodology employed and the structure of the thesis. It also outlined the scope and limitations of the research in addition to highlighting the overall contribution of the research.

Chapter Two examined the theoretical considerations in marine resource management by emphasising the characteristics of marine environmental resources, their management and principles of ecosystems based management. The historical evolution of marine resource management practices, institutional arrangements for marine resource management and the use of Marine Protected Areas (MPAs) to achieve ecosystems based marine fishery management were elucidated. This was in addition to tracing the evolution of the LME concept, its significance and the importance of indicators for marine resource assessment and management. The chapter also identified the lack of specific sub-LME indicators for the assessment and management of areas of sub-LME scale such as the research area.

Chapter Three traced the historical evolution of marine resource sustainability assessments by highlighting the global succession in indicators development and deciphering the justification for the employment of the TWAP-LME indicators for the research. This was in addition to identifying the global trends in the deployment of indicators for marine fishery assessments and management. The chapter traced the evolution of the concept of joint development arrangements over marine

resources in addition to exemplifying the management of marine resources in a disputed area. It also expounded on IUU fishing, its prevalence around the research area, and ways of curbing or managing it and how alternative schemes may be employed in managing it.

Part Two presented the techniques employed for the research; which is the case study approach. It critically explored the theoretical underpinnings of the approach and its application to the research which is intended to demonstrate the narrative accounts of the stakeholders' management structure, policies adopted for the JDZ fisheries, nature of fishing within the JDZ, nature of IUU fishing around the JDZ as well as the chosen stakeholders' level of awareness and employment of indicators. Chapter Four presented the methodology employed for the stages involved in the field surveys. Emphasis was placed on the theoretical classification of the case study approach, its advantages and disadvantages. This was in addition to questionnaires and interviews used for the research as well as their strengths and limitations.

Chapter Five was particularly concerned with the application of the approach used for the research. This was undertaken by detailing the processes and procedures employed for the survey, the location of the stakeholders and the organisations recruited for the research. The Chapters in Part Two (Four and Five) provided an overall understanding of the field survey conducted in addition to the data obtained. The respondents from across four different countries comprising of the identified stakeholders were organised and grouped according to the main themes of the survey.

Part Three presented the analysis of the data obtained and the evaluation of the indicator performance against other similar models. Chapter Six explored the objectives of the survey by analysing data from the details of the main survey themes which revealed a number of aligned, varying and distinctive issues addressed by the survey. In conclusion, a number of patterns that evolved between and among individual stakeholders' positions relating to the themes of the survey emerged. These core underpinning themes are presented in Section 9.3.

### 9.3 Core underpinning themes

- The JDA has been confirmed to be the only constitutionally recognised body set up to manage the overall resources (both hydrocarbons and non-hydrocarbons) of the JDZ.
- It is also the main regulator of all the affairs that take place within the JDZ including all aspects of monitoring, licencing and governance pursuant to Article 8 of the JDZ treaty. (See Appendix One).
- That some variations exist from across a varied range of stakeholders in terms of their organisational roles, involvement with the JDZ fisheries management, how their organisations fit and how the JDZ fisheries resources are monitored.
- That there exists a variety of policy adoptions by different stakeholders who sometimes differ and sometimes concur with their varying policy approaches as far as the JDZ fisheries resources are concerned.
- That there is currently not in place a substantive fishery regime for the JDZ fisheries but plans are underway towards establishing one.
- There is currently not in place a substantive licencing system but steps have been found to be taken towards establishing one along with the regime.
- There is to a significant extent an IUU fishing proliferation around the research area with majority of the revelations pointing to the EU and Asian nations as the main sources.
- Although participants differed on percentage of fisheries that suffers from IUU fishing, there was near consensus on the need for deployment of modern technologies and stiffer sanctions to curb it and create deterrence.
- That there is inadequate awareness on the use and employment of indicators from across the broad spectrum of stakeholders and that the main resource managers (the JDA) indicated insufficient efforts towards imbining indicator-based sustainability assessment.
- There is a clear lack of integration; synergy and general awareness between and among the identified stakeholders as far as the activities of the JDZ are concerned; which is imperative and a necessary recipe for the sustainable JDZ marine fishery resource management.

Chapter Seven further expounded on the evaluation of indicators' performance based on the analysis against other similar models. The current levels of the JDZ fisheries management in terms of the five main themes, namely; the management structure, management policies adopted for JDZ fisheries, nature of fishing within the JDZ, nature of IUU fishing around the JDZ and level of awareness and employment of indicators. The themes were evaluated against the ideal indicator requirements.

- ***The management structure***

It is clear, therefore that there are inadequate and inappropriate institutional frameworks in place for the sustainable management of the JDZ fisheries. This was made more manifest as a result of the absence of a substantive marine fishery regime after over a decade of the JDZ operations. There was also a lack of cooperation and collaboration among the identified stakeholders for the JDZ fisheries where strong concerns were revealed on a number of issues depicting absence of synergy. Management intervention initiatives were also found to be unevenly distributed between and among a varied range of stakeholders. While evidence suggested a prolonged involvement by individual stakeholders with their organisations, there is little or no evidence of a unified monitoring and involvement with the JDZ fisheries by the different stakeholders.

- ***Management policies adopted for JDZ fisheries***

It can be stated that the management policies adopted for the JDZ fisheries are consistent between and among majority of the stakeholders. These are to develop alternative sources of income for the two nations, sustainable exploration and exploitation, as well as the determination of the abundance and distribution of the resource. Others are compliance with existing treaties, statutes and conventions, design of initiatives and interventions capable of preventing and controlling the IUU fishing. Another policy is the attraction of capable investors for the JDZ fishery resources and also ensuring convergence between individual stakeholder's policies with others within the zone.

- ***Nature of fishing within the JDZ***

It can be concluded that there is yet to be in place a substantive marine fishery regime for the JDZ fisheries after over a decade of its operations. It is also clear, that there is an absence of consensus between the stakeholders as to who should be responsible for the regime as a result of issues of jurisdiction because of the location of the JDZ. As a result of this, there is currently no licensing or quota system in place for the JDZ fisheries although it has been obtained that the potential regime is intended to be licence-based. It is also the conclusion of the research that the contributions by stakeholders to ensure the JDZ resource sustainability are currently sporadic and varied. This could have been the reason why fishing activities around the zone are currently unmonitored, uncoordinated and as such uncontrollable.

- ***Nature of IUU fishing around the JDZ***

It is clear from the analysis that while the percentage of species affected by the IUU fishing is unknown, the types affected are mainly tuna and shrimps. There is also a consensus among stakeholders on the main sources of the IUU fishing, which are believed to be mainly from the EU and Asian vessels. The IUU fishing was also found to be prevalent as a result of an unholy alliance between the perpetrators and government personnel. There has equally been observed, a lack of synergy between stakeholders' IUU fishing management strategies occasioned by inadequate capacity, distrust and mutual suspicions. All stakeholders were unanimous however on the appropriate ways of mitigating, curbing and controlling the IUU fishing challenge. This is through strengthening cooperation, use of satellite technology, persistent inspection and stringent fines capable of creating deterrence.

- ***Level of awareness/ employment of indicators***

It is the conclusion of this research that while there is appreciable level of awareness of sustainability issues such as Agenda 21, only an insignificant number of stakeholders are actually aware of indicator-based sustainability assessment and

management. There are however a few attempts in place based on some stakeholders' situations and areas of jurisdiction such as periodic reports on catches, deployment of VMS to monitor fish landings, MSY and size variations. While none of these attempts actually covers or transcends the JDZ due to its location and uniqueness, evidence suggested that almost all the stakeholders are currently in liaison with one or more other stakeholders to develop capacity with a view to ensuring an indicator-based sustainability assessment and management for the JDZ fisheries in the foreseeable future.

Part Four was concerned with the critical implications, recommendations and Conclusions. Chapter Eight analysed the viability of the current deployment of indicators in conjunction with the analysis, the feedback and comments returned by the main stakeholders. The feedback and comments were integrated in terms of the JDA's selection and scoring of the candidate indicators based on the outcomes of the initial survey analysis.

This further revealed the status of the TWAP-LME indicators to the JDZ fisheries. It is therefore the conclusion of the research that while the JDA can be said to be optimal in some indicators' deployment, it has been found to be sub-optimal in most of the indicators' deployment. This is based on the feedback and comments returned by the JDA in terms of the current management arrangements in place for the sustainable JDZ marine fishery assessments and management. As such significant institutional arrangements in addition to closer cooperation between and among critical stakeholders are needed for the JDA to address the observed shortcomings.

It is also the conclusion of this research that, from the conclusions, not all among the TWAP-LME indicators can be applied to an area such as the JDZ-an area of sub-LME scale-due to the uniqueness and location of the JDZ.

Chapter Nine provided conclusions from the research by focusing on the main conclusion, recommendations and implications for further research arising from the conclusions reached.

## 9.4 Recommendations

Based on the analysed survey data and the feedback and comments from the JDA it is of critical importance to put forward some robust recommendations that may be used or employed (1) to improve indicator-based marine fishery sustainability assessment and management within the JDZ and (2) to provide lessons for similar scenarios. They are also developed based on the choices made by the JDA and in line with the principles of their development which requires the input of the potential users. As well as taking into consideration their situations and positions-in this case the current management arrangements in place for the sustainable management and assessment of the JDZ marine fishery.

- ***List of candidate indicators that can be applied to the JDZ marine fishery assessment***

While not all among the recommended indicators are chosen or selected by the JDA, it is also noteworthy that the recommendations are based on the uniqueness of the JDZ, the current arrangements in place for the sustainable JDZ fisheries assessment and management as revealed from the analysis as well as the practicality of their implementations in terms of the ideal indicator requirements, namely; acceptability, data availability, robustness, comprehensiveness, cost-effectiveness and practicality. As such, eleven of the recommended indicators are among the JDA-chosen set while seven are not. However, the recommendations are solely based on size, location and uniqueness of the JDZ regardless of the choices and selections they made from their feedback and comments. They are recommended as the most appropriate, suitably tailored and practicable sets in the prevailing circumstances. Therefore, in consideration of the size and location of the JDZ and the integration of the returned feedback and comments, the following list of eighteen indicators is hereby recommended. They are considered most suitable and appropriate due to the uniqueness of the JDZ and are hereby recommended for the sustainable management and assessment for the JDZ marine fisheries. The details of the indicators have already been provided in sections 3.6.4 to 3.7. They are:

1. Primary productivity
2. Sea surface temperature
3. Oceanographic fronts
4. Reported landings
5. Value of reported landings
6. Mercury contamination
7. Nutrients indicator
8. Negative trends in Dissolved Oxygen Concentration
9. Shipping density
10. Harmful Algal Bloom
11. Sediment discharge
12. Seamounts at risk
13. Marginal economic value
14. Marine Trophic Index (MTI) and Fish in Balance Index (FIB)
15. Ecological footprints of fisheries
16. LME carrying capacity in relation to Maximum Sustainable Yield (MSY)
17. GDP fisheries
18. Change in protected area coverage

- ***Justification of the recommended indicators***

Indicators 1, 2 and 3 are recommended for their ability to appraise productivity and the JDZ ecosystem's condition thereby enabling informed practical management intervention initiatives. Indicators 4 and 5 are expected to significantly indicate the potential benefits accruable to the two nation states' citizens whenever the fishery regime becomes fully operational. Indicators 6, 7 and 8 are recommended due to their ability to appraise the health of the ecosystem; which is very important for determination of the wellbeing of the JDZ species.

Although, there is currently no known practice of indicator 6 for African LMEs due to lack of data, it is strongly recommended because of the indicator's ability to appraise marine atmospheric persistence of mercury contamination-potentially likely occurrence at the JDZ-due to hydrocarbon exploration. Furthermore, capacity

for its data can be arranged in conjunction with the NOAA or the 'UBC Sea around us project'. Similarly, indicator 7 is included due to its ability to measure the nutrients level of the JDZ ecosystem despite being yet to be tested in any TWAP-LME assessment. Its data can be organised and accessed for the JDZ in conjunction with the NOAA; who can produce visuals and maps capable of computing the spatially-explicit global watershed model (NEWS).

Indicator 8 is known to be very important for marine lives communities most especially in their ability to appraise negative trends in dissolved oxygen concentration in time series. Data for the global LMEs can be obtained from the Scientific Committee on Ocean Research (SCOR). Indicator 9 is recommended and considered very important for the JDZ assessment because of the finding from the research that indicated the JDZ area to be among the favoured routes for marine transportation and as such appraising the shipping density cannot be over-emphasised.

Indicators 10, 11 and 12 are recommended as a result of their ability to measure the health of the marine ecosystem. Although, the data on indicator 10 exists with NOAA Harmful Algal Blooms Observing System (HABSOS) and can be easily obtained for the JDZ, data on indicators 11 and 12 are not easily accessible. However, they can be computed by the JDA for the JDZ from their 2013 bottom fauna, selected physical and chemical compounds survey conducted in conjunction with the Norwegian Institute of Marine Research.

Indicator 13 is included for its ability to identify the value gained or lost by change in stock productivity and as such very useful when full commercial fishing activities commence thereby allowing the two nation states determine any value added to their investments from fisheries.

Indicator 14 is very important in indicating changes to ecosystems provisioning services occasioned by fishing and data exists with the FAO and UBC Sea around us project or can easily be computed by the JDA for the JDZ based on their recently conducted bottom fauna, selected physical and chemical compounds survey.

Indicator 15 is considered very strong in determining fishery sustainability when combined with indicator 1 and its data and methodology are similar as well and can be computed for the JDZ by estimation since global time series for all LMEs exist with the UBC Sea Around Us Project.

Indicator 16 is significant in determining changes to ecosystem structure and process and is computed using Ecopath with Ecosim (EwE) software by estimation of fish biomass. Data and capacity for EwE can be accessed from the NOAA, GEF and UBC Sea around us project and the JDA as an institution can easily access that.

Indicator 17 is recommended due to its ability to indicate value achievable from fisheries per any given nation. This is very important as an indicator for each of the two nation states to measure its citizens' dependence on JDZ fisheries provisioning services.

Indicator 18 is recommended in that it appraises ecosystem's health. The issue with its integrity can be mitigated if the JDA will focus on the JDZ by seeking the exact location's GIS formats from UNEP-WCMC and validate same with the Nigeria's National Space Research Development Agency's GIS layers for the same area.

Section 7.6 itemised the steps to be followed in establishing an appropriate system of indicator-based fisheries management regime through some eight practical steps which must be followed by the JDA in employing the indicators.

It is also proposed that in terms of validating the governance of the recommended indicators upon their deployment and in line with the JDA's current governance status (Sections 8.8 to 8.8.4); the JDA must ensure the following conditions are met:

- The development and strengthening of synergies between and among critical stakeholders with a view to taking on board all partners to the extent that each one of them becomes aware of what the situation of the fisheries is at any given time. This will ensure suitable integration and help greatly in reducing duplication of efforts by varying stakeholders in addition to fostering enabling conditions where direct and indirect stakeholders aim for the same goal for the JDZ marine fisheries sustainability.

- The plan to obtain permissions from both Nigeria and the Democratic Republic of Sao Tome & Principe possible incursion into each of their EEZs for licence holders is pursued vigorously with a view to settling or foreclosing jurisdictional issues. This is very important considering the size and location of the JDZ and the migratory nature of the fishery stocks. It shall also be followed by mutually establishing a Marine Protected Area (MPA) within the JDZ with a view to safeguarding the fisheries since they are located in a known zone of oil and gas exploration and exploitation activities.
- Ensure the development and strengthening of the JDA's monitoring and inspection department with a view to expanding its scope to cover all aspects of fishing activities and assume its statutory role of an overall regulator within and among all direct and indirect stakeholders. This is necessary to ensure appropriate institutional frameworks are in place for evaluating sustainable JDZ conditions and uses in addition to provision of effective and efficient monitoring platform for the recommended list of candidate indicators.
- Hasten the establishment of the proposed joint military patrol for the zone with a view to curbing the prevailing IUU fishing activities. This shall be in addition to proclaiming stringent measures for the punishment of offenders with a view to creating deterrence. Measures must also be put in place to liaise with GIS-based technology providers such as the NOAA, the British Geological Survey, the Meteorological Office and the Nigeria's National Space Research deployment Agency so that appropriate satellite technologies are employed to manage the IUU fishing and improve the potential revenue base from the JDZ fishery resources.

## 9.5 Implications for further studies

This research examined the JDZ marine fishery sustainability by evaluating the viability and feasibility of implementing the TWAP-LME indicators to the JDZ in view of its uniqueness-an area of sub-LME scale-and the prevalence of IUU fishing around the area. Its main focus is on the perception of the carefully identified stakeholders on the viability of the indicators' application as well as on the status of the current indicators deployment for the sustainable management of the JDZ fisheries. From the conclusions that emerged and due to the fact that the research is limited to the stakeholders' narratives it is envisaged that a further study is needed. This study may explore the quantification of the recommended indicators with a view to providing more detailed insights into their workability when fully implemented. Furthermore, another study that may be useful to the JDZ is for the determination of the exact JDZ and similar stocks using quantitative fisheries data with the UBC Sea Around Us Project; which holds a large compendium of quantitative data for all the LMEs as well as for all established EEZs. This will be in addition to another research project that should aim to provide lessons and insights into the issues of cross-boundary EEZ jurisdictions.

## 9.6 Summary

Chapter Nine concluded the research by highlighting details of the key conclusions from the emerged patterns and themes contained in each of the chapters in the thesis.

It further put forward a set of key recommendations based on the analysed data as well as the returned feedback and comments from the JDA regarding the current managements in place for the sustainable JDZ marine fisheries assessment and management along with their justification.

It then highlighted the avenues upon which further studies can be developed or launched with a view to improving the knowledge and workability of implementing indicators to areas such as the JDZ.

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# **Appendix One**

## **The Treaty**

**TREATY**

**between**

**The Federal Republic of Nigeria**

**and**

**The Democratic Republic of São Tomé e Príncipe**

**on the Joint Development  
of Petroleum and other Resources,  
in respect of Areas of the  
Exclusive Economic Zone of the  
two States**

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**THE FEDERAL REPUBLIC OF NIGERIA**

and

**THE DEMOCRATIC REPUBLIC OF SÃO TOMÉ E PRÍNCIPE,**

**TAKING INTO ACCOUNT** the United Nations Convention on the Law of the Sea done at Montego Bay on 10 December 1982 and, in particular, Article 74(3) which requires States with opposite coasts, in a spirit of understanding and co-operation, to make every effort, pending agreement on delimitation, to enter into provisional arrangements of a practical nature which do not jeopardize or hamper the reaching of final agreement on the delimitation of their exclusive economic zones;

**FULLY COMMITTED** to maintaining, renewing and further strengthening the mutual respect, friendship and co-operation between their two countries, as well as promoting constructive neighbourly co-operation;

**ACKNOWLEDGING THE EXISTENCE** of an area of overlapping maritime claims as to the exclusive economic zones lying between their respective territories (“the Area”);

**DETERMINED** to pursue their common economic and strategic interests;

**NOTING** the possibility that petroleum and other resources may exist in the Area;

**DESIRING** to enable the exploration for and exploitation of those resources without delay and in an orderly fashion;

**MINDFUL** of the interests which their countries share as immediate neighbours, and in a spirit of co-operation, friendship and goodwill;

**CONVINCED** that this Treaty will contribute to the strengthening of the relations between their two countries; and

**BELIEVING** that the establishment of joint arrangements to permit the exploration for and exploitation of petroleum and other resources in the Area will further augment the range of contact and co-operation between the Governments of the two countries and benefit the development of contacts between their peoples;

**HAVING DECIDED ACCORDINGLY TO CONSTITUTE** by the present Treaty a Joint Development Zone for the Area, without prejudice to the eventual delimitation of their respective maritime zones by agreement in accordance with international law;

**REAFFIRMING** that the rules of international law will continue to govern questions not regulated by the provisions of this Treaty;

**HAVE AGREED AS FOLLOWS:**

## PRELIMINARY

### ARTICLE 1: DEFINITIONS

For the purpose of this Treaty:

1. "applicable law" means this Treaty, and the principles and rules of law applicable in the Zone by virtue of this Treaty;
2. "Authority" means the Joint Authority established by Part Three of this Treaty;
3. "Board" means the Board of the Authority, as referred to in Article 10;
4. "contract area" means a part of the Zone which is the subject of a development contract, but excluding areas which have been relinquished by the contractor;
5. "contractor" means a party to a development contract other than the Authority;
6. "Council" means the Joint Ministerial Council established under Part Two of this Treaty;
7. "development activity" means any economic activity in or concerning the Zone, including petroleum activity, fishing activity, all other activities for the development or exploitation of other mineral or living resources of the Zone, and all forms of exploration and research relating to any of the foregoing;
8. "development contract" means any agreement (including leases, licences, production sharing contracts and concessions) from time to time entered into between the Authority and a contractor in relation to a development activity;
9. "exclusive maritime area" means any area of continental shelf or exclusive economic zone, outside the Zone, which pertains to one or other of the States Parties under international law;
10. "financial terms" includes all obligations in the nature of taxation (whether production or income based) and any other financial obligations including royalties, payments in kind, production sharing arrangements and resource rentals;

11. "fishing activity" means any activity concerning the harvesting and exploitation of the living natural resources of the Zone;
12. "installation" means any structure, device or artificial island utilised in development activities, installed above, in, on or under the seabed including drilling vessels *in situ*;
13. "national" means a natural or juridical person having the nationality of a State Party in accordance with the laws of that State Party;
14. "national body" means a Ministry or a governmental or quasi-governmental administrative or technical organ of a State Party responsible for activities in or in the waters of that State Party;
15. "operating agreement" means a contract concluded between two or more contractors for the purpose of carrying out development activities in the Zone;
16. "operator" means a contractor appointed and acting as operator under the terms of an operating agreement;
17. "petroleum" means:
  - (a) any hydrocarbon or mixture of hydrocarbons, whether in a gaseous, liquid or solid state, naturally occurring beneath the seabed; and
  - (b) any petroleum as defined by sub-paragraph (a) that has been returned to a reservoir; and
  - (c) any other minerals which are produced in association with them;
18. "petroleum activities" means all activities of exploration for and exploitation of the petroleum in the Zone;
19. "petroleum contractor" means a contractor in respect of a petroleum development contract;
20. "petroleum development contract" means a development contract relating to petroleum;
21. "pollution" means the introduction of substances or energy into the marine environment, including estuaries, which results or is likely to result in deleterious

effects such as harm to living resources and marine life, hazards to human health, impairment of quality for use of sea water or reduction of amenity;

22. "Secretariat" means the secretariat of the Authority as referred to in Article 14;
23. "Special Regime Area" means the area more particularly defined in paragraph 1 of the Appendix;
24. "States Parties" means the Federal Republic of Nigeria and the Democratic Republic of São Tomé e Príncipe;
25. "Zone" means, subject to Article 5 and paragraph 5 of Article 31, the area of seabed and subsoil, together with the superjacent waters, established as a joint development zone under Article 2;
26. "Zone Plan" means the development plan or plans from time to time adopted by the Council, pursuant to Part Seven of this Treaty, for activities in the Zone.

**PART ONE – THE JOINT DEVELOPMENT ZONE**

**ARTICLE 2: ESTABLISHMENT OF JOINT DEVELOPMENT ZONE**

2.1. The Zone is hereby established as an area of joint development by the States Parties in accordance with, and for the purposes set out in, this Treaty.

2.2. The area covered by the Zone shall be as follows:

(a) the area of the sea which is bounded by geodesic lines joining the following points using the WGS 84 Datum in the order listed below; and

(b) the seabed, subsoil and the superjacent waters thereof.

<b>DEGREES</b>	<b>MINUTES</b>	<b>SECONDS</b>		<b>DEGREES</b>	<b>MINUTES</b>	<b>SECONDS</b>	
03	02	22	N	07	07	31	E
02	50	00	N	07	25	52	E
02	42	38	N	07	36	25	E
02	20	59	N	06	52	45	E
01	40	12	N	05	57	54	E
01	09	17	N	04	51	38	E
01	13	15	N	04	41	27	E
01	21	29	N	04	24	14	E
01	31	39	N	04	06	55	E
01	42	50	N	03	50	23	E
01	55	18	N	03	34	33	E
01	58	53	N	03	53	40	E
02	02	59	N	04	15	11	E
02	05	10	N	04	24	56	E
02	10	44	N	04	47	58	E
02	15	53	N	05	06	03	E
02	19	30	N	05	17	11	E
02	22	49	N	05	26	57	E
02	26	21	N	05	36	20	E
02	30	08	N	05	45	22	E
02	33	37	N	05	52	58	E

DEGREES	MINUTES	SECONDS		DEGREES	MINUTES	SECONDS	
02	36	38	N	05	59	00	E
02	45	18	N	06	15	57	E
02	50	18	N	06	26	41	E
02	51	29	N	06	29	27	E
02	52	23	N	06	31	46	E
02	54	46	N	06	38	07	E
03	00	24	N	06	56	58	E
03	01	19	N	07	01	07	E
03	01	27	N	07	01	46	E
03	01	44	N	07	03	07	E
03	02	22	N	07	07	31	E

2.3. The area covered by the Zone is depicted for illustrative purposes on the attached map. The Authority may for its purposes more accurately depict the boundaries of the Zone on a chart or charts of appropriate scale.

### **ARTICLE 3: PRINCIPLES OF JOINT DEVELOPMENT**

3.1. Within the Zone, there shall be joint control by the States Parties of the exploration for and exploitation of resources, aimed at achieving optimum commercial utilization. The State Parties shall share, in the proportions Nigeria 60 per cent., São Tomé e Príncipe 40 per cent., all benefits and obligations arising from development activities carried out in the Zone in accordance with this Treaty.

3.2. No development activities shall be conducted or permitted in the Zone except in accordance with this Treaty.

3.3. The rights and responsibilities of the States Parties to develop the Zone shall be exercised by the Council and the Authority in accordance with this Treaty.

3.4. The petroleum and other resources of the Zone shall be exploited efficiently in accordance with this Treaty having due regard to the protection of the marine environment, and in a manner consistent with generally accepted good oilfield and fisheries practice.

- 3.5. Subject to paragraph 4, the Council and the Authority shall take all necessary steps to enable the commencement of exploration for and exploitation of the petroleum resources of the Zone as soon as possible after the entry into force of this Treaty.

**ARTICLE 4: NO RENUNCIATION OF CLAIMS TO THE ZONE**

- 4.1. Nothing contained in this Treaty shall be interpreted as a renunciation of any right or claim relating to the whole or any part of the Zone by either State Party or as recognition of the other State Party's position with regard to any right or claim to the Zone or any part thereof.
- 4.2. No act or activities taking place as a consequence of this Treaty or its operation, and no law operating in the Zone by virtue of this Treaty, may be relied on as a basis for asserting, supporting or denying the position of either State Party with regard to rights or claims over the Zone or any part thereof.

**ARTICLE 5: SPECIAL REGIME**

- 5.1. The provisions of this Treaty (except this Article, Articles 1, 2, 4, 50, 51, paragraphs 2 and 3 of Article 52 and the Appendix) shall not apply to the Special Regime Area, and references therein to the Zone shall be read and construed accordingly.
- 5.2. The Special Regime Area shall for the duration of this Treaty be administered in accordance with the provisions of the Appendix.

## **PART TWO: THE JOINT MINISTERIAL COUNCIL**

### **ARTICLE 6: COMPOSITION OF THE COUNCIL**

- 6.1. A Joint Ministerial Council for the Zone is hereby established.
- 6.2. The Council shall comprise not less than two nor more than four Ministers or persons of equivalent rank appointed by the respective Heads of State of each State Party.
- 6.3. The Council does not have separate legal personality.
- 6.4. Any member of the Council may by written notice to the Secretariat nominate a representative to participate on his or her behalf at one or more meetings of the Council. Subject to the specific terms of the nomination, every such representative shall be entitled, in the absence of the designating member, to exercise any power or function of that member as a member of the Council, including counting towards a quorum.
- 6.5. The Executive Director acting as Secretary of the Authority shall also act as Secretary of the Council.

### **ARTICLE 7: MEETINGS AND DECISIONS OF THE COUNCIL**

- 7.1. The quorum for a valid meeting of the Council shall be at least half the members, including at least one appointed by each of the States Parties.
- 7.2. The Council shall meet at least twice a year and as often as may be required, alternately in Nigeria and in São Tomé e Príncipe. The first meeting shall be held not later than 60 days after the entry into force of this Treaty.
- 7.3. Meetings shall be chaired by a member nominated by the host State Party.
- 7.4. All decisions of the Council shall be adopted by consensus.
- 7.5. The Council may establish its own procedures, including procedures for taking decisions out of session.
- 7.6. No decision of the Council shall be valid unless it is recorded in writing and signed by at least one member from each State Party.

## **ARTICLE 8: FUNCTIONS AND POWERS OF THE COUNCIL**

- 8.1. The Council shall have overall responsibility for all matters relating to the exploration for and exploitation of the resources in the Zone, and such other functions as the States Parties may entrust to it.
- 8.2. The functions of the Council shall include the following:
- (a) to give directions to the Authority on the discharge of its functions under this Treaty;
  - (b) to approve rules, regulations (including staff regulations) and procedures for the effective functioning of the Authority;
  - (c) to consider and approve the audited accounts and audit reports of the Authority;
  - (d) to consider and approve the Annual Report of the Authority;
  - (e) to review the operation of this Treaty and to make recommendations to the States Parties on any matter concerning the functioning or amendment of this Treaty as may be appropriate;
  - (f) to approve development contracts which the Authority may propose to enter into with any contractor;
  - (g) to approve the termination of development contracts entered into between the Authority and contractors;
  - (h) subject to the provisions of paragraph 2 of Article 18, to approve the distribution to the States Parties of revenues or products derived from development contracts in the Zone;
  - (i) to consider and approve the annual budget of the Authority;
  - (j) to approve the opening of bank accounts by the Authority;
  - (k) to vary any time limit imposed upon the Authority under the terms of this Treaty;

- (l) through consultation, to settle disputes in the Authority;
- (m) to appoint the external auditors for the Authority and approve their remuneration.

8.3. Each of the States Parties shall have full access on request to all papers of the Council and the Authority.

8.4. The Council, its members and its Secretary shall be entitled to use the services of the Secretariat of the Authority as necessary for the discharge of their functions under this Treaty.

### **PART THREE: THE JOINT AUTHORITY**

#### **ARTICLE 9: ESTABLISHMENT, FUNCTIONS AND POWERS**

- 9.1. The Authority is hereby established.
- 9.2. The Authority shall have juridical personality in international law and under the law of each of the States Parties and such legal capacities under the law of both States Parties as are necessary for the exercise of its powers and the performance of its functions. In particular, the Authority shall have the capacity to contract, to acquire and dispose of movable and immovable property and to institute and be party to legal proceedings.
- 9.3. The Authority shall be responsible to the Council.
- 9.4. Unless and until the Council otherwise decides, the seat of the Authority shall be at Abuja, Nigeria, with a subsidiary office in São Tomé, São Tomé e Príncipe .
- 9.5. The Authority shall commence functioning on entry into force of this Treaty.
- 9.6. The Authority, subject to directions from the Council, shall be responsible for the management of activities relating to exploration for and exploitation of the resources in the Zone, in accordance with this Treaty. In particular, the Authority shall have the following functions:
  - (a) the division of the Zone into contract areas, and the negotiation, tendering for and issue and supervision of contracts with respect to such areas;
  - (b) entering into development contracts with contractors, subject to the approval of the Council;
  - (c) oversight and control of the activities of contractors;
  - (d) recommending to the Council the termination of development contracts;
  - (e) terminating development contracts, subject to the approval of the Council;
  - (f) subject to paragraph 2 of Article 18, collecting and, with the approval of the Council, distributing between the two States Parties the proceeds or products of the Authority's share of production from development contracts;

- (g) preparation of budgets of the Authority for submission to the Council. Expenditure shall be incurred in accordance with budgets or estimates approved by the Council or otherwise in accordance with regulations and procedures approved by the Council;
- (h) controlling the movements into, within and out of the Zone of vessels, aircraft, structures, equipment and people;
- (i) the establishment of safety zones and restricted zones, consistent with international law, to ensure the safety of navigation, petroleum activities, fishing activities and other development activities and the effective management of the Zone;
- (j) issuing regulations and giving directions on all matters related to the supervision and control of operations, including on health, safety and environmental issues;
- (k) the regulation of marine scientific research;
- (l) preparation of Annual Reports for submission to the Council;
- (m) inspecting and auditing contractors' books and accounts relating to development contracts, for any calendar year;
- (n) making recommendations to the States Parties on any issues arising as to the applicable law, and on any changes to that law which may be necessary to promote the development of the resources of the Zone;
- (o) the preservation of the marine environment, having regard to the relevant rules of international law applicable to the Zone;
- (p) the collection and exchange of scientific, technical and other data concerning the Zone and its resources;
- (q) the appointment and dismissal of technical and other staff of the Authority other than Executive Directors;
- (r) requesting action by the appropriate authorities of the States Parties consistent with this Treaty, in respect of the following matters:
  - (i) search and rescue operations in the Zone;
  - (ii) deterrence or suppression of terrorist or other threats to vessels and

- structures engaged in development activities in the Zone; and
- (iii) the prevention or remedying of pollution;
  - (s) consideration of matters from time to time specifically referred to it by the Council or by either State Party; and
  - (t) such other functions as may be conferred to it by the Council.

9.7. The working language of the Authority shall be English.

## **ARTICLE 10: THE BOARD**

- 10.1. Subject to this Treaty and to any direction of the Council, the Authority shall be governed by a Board consisting of four Executive Directors. Two (and their replacements from time to time) shall be appointed by the Head of State of Nigeria from among Nigerian nationals of suitable qualifications and experience, and two (and their replacements from time to time) shall be appointed by the Head of State of São Tomé e Príncipe from among nationals of São Tomé e Príncipe, of suitable qualifications and experience. All such appointments shall be effected by notice in writing served upon the Head of the other State Party. Executive Directors shall hold office for such period as the appointing Head of State shall determine, normally for a period of six years once renewable or until a replacement is appointed.
- 10.2. Executive Directors may from time to time be assigned by the Council, on a three year basis, to head various departments of the Authority, including to act as Secretary of the Authority and Head of the Secretariat.
- 10.3. The Board shall meet on the request of the Council, either State Party or any Executive Director, or otherwise, as often as necessary for the discharge of its functions.
- 10.4. The quorum for a valid meeting of the Board shall be at least two Executive Directors, including at least one appointed by each State Party.
- 10.5. Decisions of the Executive Directors of the Authority shall be arrived at by consensus. Where consensus cannot be reached, the matter shall be referred to the Council.

- 10.6. Unless the Board otherwise decides, it shall meet at the seat of the Authority.
- 10.7. No decision of the Board shall be valid unless recorded in writing and signed by two Executive Directors, including at least one appointed by each State Party.
- 10.8. The personnel of the Authority shall be appointed by the Board under terms and conditions, approved by the Council, that have regard to the proper functioning of the Authority.
- 10.9. Unless the Council otherwise decides, it shall appoint one of the Executive Directors to act as Chairman of the Authority and of the Board, such appointments to be for a one year period.
- 10.10. Subject to this Treaty and to any direction of the Council, the Board may determine its own procedures.

#### **ARTICLE 11: ACCOUNTABILITY**

- 11.1. The Authority shall in all respects be responsible and accountable to the Council and shall comply with all directions from time to time given to it by the Council.
- 11.2. The Secretariat and all other administrative agencies or organs and technical or other committees of the Authority shall in all respects be responsible and accountable to the Board.
- 11.3. The Authority shall produce an Annual Report on its activities and on the progress made in the Zone, in accordance with any directions of the Council, and shall submit it to the Council for approval.

#### **ARTICLE 12: PRIVILEGES AND IMMUNITIES**

- 12.1. The Authority shall be immune from all forms of taxation in respect of its activities under this Treaty. This is without prejudice to the application of non-discriminatory fees or charges for services in respect of activities of the Authority on the territory of a

State Party, to the extent that a national authority of that State Party would be subject to corresponding fees or charges in respect of equivalent activities.

- 12.2. The Authority shall be immune from the jurisdiction of any court or tribunal of a State Party except as concerns:
- (a) commercial transactions entered into on the territory of the State Party in question, to the extent that such transactions are not subject to dispute resolution under Article 47;
  - (b) non-discretionary decisions which would be reviewable if they were made in equivalent circumstances by a national authority on the territory of the State Party in question.
- 12.3. The Executive Directors, officers and other personnel of the Authority who are nationals of one or other State Party shall be subject to taxation in respect of any remuneration for services performed under this Treaty only by the State Party of their nationality, irrespective of where the services in question are performed.
- 12.4. A person who is a national of both States Parties shall be required to elect which of the two nationalities is to be treated as effective for the purposes of this Treaty.

### **ARTICLE 13: SUPPLY OF SERVICES**

- 13.1. Subject to this Treaty and in accordance with the principles set out in Article 3, for the accomplishment of its functions, the Authority may use technical structures and other services already existing in the States Parties. Different services may be requested from different entities.
- 13.2. The entities to which such delegation is made shall be accountable to the Authority.
- 13.3. The immunities of the Authority under paragraphs 1 and 2 of Article 12 shall apply to the activities of any entity exercising delegated functions under the present Article.

- 13.4. A delegation under paragraph 1 of this Article remains in force in accordance with its terms until it is revoked by the Board.
- 13.5. Any entity to which functions are delegated under paragraph 1 shall accept the secondment to its staff, at appropriate levels of seniority, of nominees of any State Party not already involved in the entity, for the purposes of training and exchange of information and expertise, and shall involve those persons to the fullest extent in the exercise of the delegated functions.
- 13.6. The number and placement of the persons referred to in paragraph 5 are subject to agreement between the States Parties, having regard to the extent of the functions to be performed and the needs for personnel development and training of the State Party not already involved in the entity.
- 13.7. Costs and other expenses, including personnel costs and expenses, incurred in the exercise of delegated functions, are reimbursable, subject to the terms and conditions agreed upon with the Authority.
- 13.8. The staff of or retained by the Authority (including the Secretariat) shall be selected on a basis which ensures that the maximum percentage of such staff who are nationals or residents of São Tomé e Príncipe does not exceed 40 per cent.

## **PART FOUR : ADMINISTRATIVE SERVICES**

### **ARTICLE 14: SECRETARIAT AND OTHER SERVICES**

- 14.1. The Authority shall establish a Secretariat, headed by one of the Executive Directors as Secretary on a three year rotating basis, to carry out the administrative work of the Council and the Authority.
- 14.2. All appointments to the Secretariat shall be made, by the Board, within the limits and subject to any procedures laid down by the Council.
- 14.3. The officers and staff of the Secretariat shall be recruited on such terms as the Authority approves. Senior appointments shall be subject to approval by the Council. Such officers and staff may but need not be selected from amongst the officials or employees, or former officials or employees, of the government of either State Party.

## **PART FIVE: DUTIES OF PERSONNEL**

### **ARTICLE 15: IMPARTIALITY AND CONFLICTS OF INTEREST**

- 15.1. Members of the Board, officers and other staff of the Authority in their capacities as such shall have regard to the interests of the Authority alone, and shall act with impartiality and without favouring either of the States Parties at the expense of the other. This principle shall apply equally to a national body or other entity and its personnel in respect of the exercise by it of delegated functions under Article 13.
- 15.2. Unless otherwise expressly approved by the Council, no Executive Director, officer or other staff member of the Authority may have any direct or indirect financial interest in development activities in the Zone.
- 15.3. Executive Directors, officers and other staff members of the Authority shall, before assuming their functions, make a written declaration under oath, in a form approved by the Council, detailing any direct or indirect interest which might reasonably be considered to amount to a financial interest as referred to in paragraph 2.

### **ARTICLE 16: CONFIDENTIALITY**

- 16.1. Members of the Board, officers and other staff of the Authority, as well as each State Party, shall treat the contents of all confidential papers and information produced or received for the purposes of or pursuant to this Treaty as confidential, and shall not further disclose or publish any such document or information without the authority of both State Parties or as the case may be of the other State Party.
- 16.2. No Executive Director or officer or other staff member of the Authority shall disclose, during or after the termination of their functions, any industrial secret or proprietary data which comes to the knowledge or into the possession of the Authority, or any other confidential information coming to his or her knowledge by reason of his or her holding a position in the Authority.

- 16.3. This Article does not derogate from any other obligation upon a person, or any remedy available to the Authority or to a State Party, in respect of any actual or potential breach of confidentiality.

## **PART SIX: FINANCE**

### **ARTICLE 17: BUDGETS, ACCOUNTS AND AUDIT**

- 17.1. The Authority shall be financed from revenues collected as a result of its activities. The States Parties shall advance such funds as they jointly determine to be necessary to enable the Authority to commence its operations.
- 17.2. All funds paid or payable to the Authority shall be held by the Authority in such accounts as it shall establish, in accordance with sub-paragraph 2(j) of Article 8.
- 17.3. The Authority shall prepare and maintain full, proper and up-to-date accounts, balance sheets, budgets and cash flow projections, in accordance with good international accountancy practice and with any directions of the Council.
- 17.4. All costs and expenses from time to time incurred by the Council, the Authority and their respective members and other personnel shall be paid by the Authority.
- 17.5. All such costs and expenses shall be subject to a budgetary and accounting system to be established by the Authority and approved by the Council within five months of the entry into force of this Treaty.
- 17.6. All budgets, costs and expenses, and in addition all other receipts and payments by the Authority, and all accounts of the Authority, shall be audited annually by external auditors approved by the Council.
- 17.7. Any shortfall in the approved budget for any accounting period shall be borne by the States Parties in the proportions Nigeria 60 per cent., São Tomé e Príncipe 40 per cent. Unless the Council otherwise decides, budgetary contributions under this paragraph shall constitute interest-free loans to the Authority, repayable as first charges on the surplus of the Authority in any subsequent accounting period.
- 17.8. The Authority shall comply with the budgetary procedures in force and shall make efficient use of its available resources.

## **ARTICLE 18: APPLICATION OF SURPLUSES**

- 18.1. The Authority may with the approval of the Council establish such reserve funds as it considers prudent.
- 18.2. All surpluses of revenue over expenditure shall, after the establishment of such reserve funds, be promptly paid, without deduction or withholding, to the national treasuries of the States Parties in the proportions Nigeria 60 per cent, São Tomé e Príncipe 40 per cent, as shall any sum held in a reserve fund which is no longer required.

## **PART SEVEN: THE ZONE PLAN**

### **ARTICLE 19: PREPARATION AND APPROVAL OF THE ZONE PLAN**

- 19.1. As soon as practicable following the entry into force of this Treaty the Authority shall meet in order to prepare an initial Zone Plan in accordance with the principles set out in Article 3, so as to establish ways in which the resources of the Zone may be developed in an efficient, economical and expeditious manner.
- 19.2. For the purposes of paragraph 1, the States Parties have provided each other with all material information available to them in respect of economic activity, actual or prospective, within the Zone.
- 19.3. The Zone Plan is subject to the approval of the Council, which may approve it with or without amendment or refer it back to the Authority with recommendations for further work or instructions for change.
- 19.4. The Zone Plan as approved by the Council shall be published in an appropriate manner by the Authority and the States Parties.
- 19.5. Matters which are not included in the Zone Plan shall be governed by this Treaty, or in the absence of any provision in this Treaty by decisions of the Council or supplemental agreement between the States Parties.

**ARTICLE 20: PERIODIC REVIEW OF THE ZONE PLAN**

- 20.1. Unless otherwise directed by the Council, the Authority shall review and revise the Zone Plan at least every three years and submit any proposed revisions to the Council for adoption.
- 20.2. Pending adoption of any revised Zone Plan the previously approved Zone Plan shall remain in force.
- 20.3. Paragraphs 3 to 5 of Article 19 apply to any proposed or approved revision of the Zone Plan.

## **PART EIGHT: REGIME FOR PETROLEUM IN THE ZONE**

### **ARTICLE 21: REGULATORY AND TAX REGIME FOR PETROLEUM ACTIVITIES**

- 21.1. As soon as practicable following the entry into force of this Treaty and in any event within a three month period, the Authority shall prepare for the approval of the Council a regulatory and tax regime consistent with this Treaty, which shall be the applicable law relating to the exploration for and exploitation of petroleum in the Zone.
- 21.2. Within six months of the entry into force of this Treaty, the draft regulatory and tax regime shall be adopted by the Council with such modifications as the Council considers appropriate. By virtue of such adoption the regime shall (subject to Article 5) become legally applicable to petroleum activity throughout the Zone, and shall be enforced accordingly by the Authority.
- 21.3. Upon its adoption, the regulatory and tax regime shall be promptly published by the Authority.
- 21.4. The Council may at any time adopt such modifications as it thinks fit to the regulatory and tax regime so established, and any such modification shall immediately become legally applicable in the Zone and enforced by the Authority.
- 21.5. The Authority shall promptly publish every such modification to the regulatory and tax regime.

### **ARTICLE 22: CUSTOMS AND DUTY EXEMPTIONS**

- 22.1. Petroleum equipment shall not be subject to any customs duties or other taxes and duties in respect of its import into, use in or export from the Zone unless and to the extent the Council otherwise decides. Nothing in this Article shall affect a State Party's rights in respect of export or import, following the completion of its use in the Zone of petroleum equipment having the territory of that State Party as its country of, respectively, origin or destination.

- 22.2. For the purposes of this Article “petroleum equipment” includes installations, plant and equipment (including drilling rigs) and any materials and other goods necessary for the conduct of petroleum activities in the Zone.
- 22.3. The shipment of petroleum extracted from the Zone to areas within the jurisdiction of the States Parties shall be free of all taxes and duties other than those provided for in the financial terms of the relevant development contract.

### **ARTICLE 23: GENERAL REGIME FOR PETROLEUM DEVELOPMENT CONTRACTS**

- 23.1. No petroleum activities may be undertaken in the Zone other than pursuant to a petroleum development contract between the Authority and one or more contractors.
- 23.2. Unless the Council otherwise decides, and in accordance with procedures laid down by the Council for tendering, the principle of holding licensing rounds must be followed prior to the signature of any petroleum development contract.

## **ARTICLE 24: FINANCIAL REGIME FOR PETROLEUM DEVELOPMENT CONTRACTS**

- 24.1. The financial (including fiscal) obligations of contractors to the Authority in respect of petroleum activities in the Zone shall be exclusively determined by the financial terms of petroleum development contracts approved under this Article.
- 24.2. In addition to the financial terms imposed by the regulatory and tax regime established pursuant to Article 21, the Authority may impose such other terms, not inconsistent with the foregoing, as it may formulate, having regard to the requirement to balance the following needs:
- (a) to obtain optimum revenues for the Authority and through the Authority the State Parties from commercial exploitation of the resources;
  - (b) to encourage commercial exploitation and provide incentives for investment;
  - (c) to ensure clarity and certainty of operation;
  - (d) to ensure as far as possible that contractors' tax payments under the financial terms qualify for double taxation relief, including in third States;
  - (e) to ensure optimum utilisation of any fields wholly or partly within the Zone over the life of those fields.
- 24.3. The States Parties shall take all appropriate measures within their national legal systems to ensure that the financial terms are enforced.
- 24.4. Neither State Party shall tax development activities in the Zone or the proceeds deriving therefrom except in accordance with this Article. This does not affect the States Parties' rights to tax any profits arising from the processing or further treatment of petroleum beyond the initial treatment necessary to effect its sale as a raw material.

## **ARTICLE 25: RIGHTS AND DUTIES OF CONTRACTORS**

- 25.1. A contractor shall have exclusive rights to carry out the activities authorised under its respective petroleum development contract for the duration of the latter, subject to compliance with its terms and the applicable law.
- 25.2. A contractor may dispose of any petroleum to which it is entitled under the relevant development contract, subject only to any non-discriminatory restrictions the Authority may impose on landing, identity of the purchaser and verification of the volumes concerned.

## **ARTICLE 26: EFFECT OF CANCELLATION OR SUSPENSION OF PETROLEUM DEVELOPMENT CONTRACTS ON CO-CONTRACTORS**

- 26.1. If following a contractor's default the Authority cancels a petroleum development contract held jointly by more than one contractor, the Authority shall offer a new contract for that area to any contractor(s) not in default, as far as possible on similar terms to those of the previous contract.
- 26.2. The offer may be subject to:
- (a) a requirement that the offeree(s) remedy any consequences of the default;
  - (b) the acceptance by the offeree(s) of a suitable replacement contractor identified by or acceptable to the Authority.
- 26.3. This Article is without prejudice to any obligations to which the other contractor(s) may be liable under the original petroleum development contract.

## **ARTICLE 27: ASSIGNMENT OF CONTRACTORS' RIGHTS**

A contractor's rights and obligations under a petroleum development contract shall not be transferred without the consent of the Authority. The Authority shall not unreasonably withhold its consent where the proposed transferee is financially and technically qualified and otherwise meets any requirements maintained by the Authority.

## **ARTICLE 28: OPERATIONS BY PETROLEUM CONTRACTORS IN THE TERRITORY OF THE STATES PARTIES OUTSIDE THE ZONE**

Within the territory of either State Party petroleum contractors may acquire, construct, maintain, use and dispose of buildings, platforms, tanks, pipelines, terminals and other facilities necessary for petroleum activities in the Zone in accordance with the laws and regulations of the State Party concerned.

## **ARTICLE 29: ACCESS TO OPERATIONS**

29.1. In accordance with the principles of joint development set out in Article 3 each State Party is entitled to:

- (a) the benefit of non-discriminatory consideration of its nationals' applications for petroleum development contracts;
- (b) monitor, and be kept regularly informed as to the progress of, petroleum development activities in the Zone;
- (c) obtain access to geological data, subject to obligations of confidentiality under Article 16 or otherwise;
- (d) independently meter, monitor or inspect any petroleum activities (including the right of access to installations in order to carry out such metering, monitoring or inspection).

- 29.2. The Authority and/or the States Parties shall adopt procedures in respect of metering production designed to ensure agreement on the quantities of petroleum uplifted.

### **ARTICLE 30: INSPECTION RIGHTS**

- 30.1. The Authority, acting either itself or through a national body or third party, shall have responsibility for the inspection of petroleum activities, related installations and pipelines pipelines, and for the supervision of operations carried out on such and pipelines installations situated in the Zone.
- 30.2. The Authority shall decide upon the certification procedures to be followed by the inspectors carrying out the activities referred to in paragraph 1.
- 30.3. Where, in the opinion of a State Party, it appears to it, following an inspection, that applicable laws are not being observed in the Zone, that State Party may by written notice request the Authority to remedy the situation.
- 30.4. If the Authority fails or refuses to take action at such request by one of the States Parties, that State Party may refer the matter to the Council.
- 30.5. Unless otherwise directed, the inspectors referred to in paragraph 1 may order the immediate cessation of any or all petroleum operations in the Zone if such a course appears necessary or expedient:
- (a) for the purpose of avoiding an accident involving loss of life or danger to life;
  - (b) for the purpose of avoiding actual or threatened damage;
  - (c) to protect the coastline or other maritime interests of either State Party, including fishing interests, against actual or potential pollution;
  - (d) due to force majeure distress or an emergency which may give rise to reasonable fears of major harmful consequences; or
  - (e) to minimise the consequences of such a casualty or other accident.

- 30.6. The content of and justification for any such order must be reported immediately to the Board.
- 30.7. The Board shall thereafter meet promptly to consider the actions necessary for the safe and speedy resumption of operations.

### **ARTICLE 31: PETROLEUM UNITISATION**

- 31.1. If any single geological petroleum structure or petroleum field exists, verified by drilling to extend across the dividing line between the Zone and an exclusive maritime area of one of the States Parties, and part of such structure or field which is situated on one side of the dividing line is exploitable, wholly or in part, from the other side of the said dividing line, either of the States Parties may give notice thereof to the other, whereupon the States Parties shall endeavour to reach agreement upon a fair and reasonable basis for the unitisation of such structure or field, having regard to the principles set out in Article 3 and the respective proportion of the petroleum located on each side of the dividing line. If such agreement is not reached within nine months following the giving of such notice, a fair and reasonable apportionment shall be made, having regard as aforesaid, of the petroleum to be taken from the structure or field. Such apportionment shall be with retrospective effect back to the start of production provided that the State Party which has given notice did so with reasonable promptitude after the verification by drilling.
- 31.2. If any single geological petroleum structure or petroleum field exists, verified by drilling to extend across the dividing line between any contract areas within the Zone, and the part of such structure or field which is situated on one side of the dividing line is exploitable, wholly or in part, from the other side of the said dividing line, the Council shall seek to reach agreement as to the manner in which the structure or field can most effectively be exploited and the manner in which the fiscal returns should be apportioned, having regard to the principles set out in Article 3 and to the respective proportion of the resource located on each side of the dividing line.
- 31.3. If any single geological petroleum structure or petroleum field exists, verified by drilling to extend across the dividing line between the Zone and an exclusive maritime

area of a third State, and the part of such structure or field which is situated on one side of the dividing line is exploitable, wholly or in part, from the other side of the said dividing line, then the Authority shall consider whether to seek to reach agreement with the third State as to the manner in which the structure or field can most effectively be exploited and the manner in which the fiscal returns shall be apportioned, having regard to the respective proportions of the resource located on each side of the dividing line and, so far as concerns the rights of the States Parties, to the principles set out in Article 3. No such agreement with a third State shall be reached without the approval of the Council

- 31.4. The Authority shall take any necessary steps, in consultation with any contractors, to give effect to any agreement reached under paragraphs 1, 2 and 3.
- 31.5. For the purposes of this Article 31, the Special Regime Area shall be treated as if it were outside the Zone and exclusively within the exclusive maritime area of Nigeria.

## **PART NINE – OTHER RESOURCES OF THE ZONE**

### **ARTICLE 32: PROVISION IN THE ZONE PLAN FOR NON-PETROLEUM RESOURCES**

The Zone Plan may make provision for non-petroleum development activities within the Zone, to such extent as the Authority considers appropriate or the Council may direct.

### **ARTICLE 33: DEVELOPMENT OF REGULATORY AND TAX REGIME**

As and when required by the Zone Plan or otherwise considered appropriate by the Council, the Authority shall prepare and submit to the Council proposals for regulatory and tax regimes applicable to non-petroleum development activities within the Zone.

### **ARTICLE 34: ARRANGEMENTS IN THE ABSENCE OF A REGULATORY AND TAX REGIME FOR NON-PETROLEUM DEVELOPMENT ACTIVITIES**

- 34.1. In the absence of any special regime proposed under Article 33 and approved by the Council, the States Parties shall apply the provisions of their own laws relating to the exclusive economic zone to the activity of their own nationals in the Zone, but shall refrain from applying those laws to the conduct of persons who are nationals of the other State Party.
- 34.2. Each State Party may accept, in accordance with its own laws, applications by non-nationals to engage in non-petroleum development activity in the Zone, but shall forthwith inform the other State Party of each such application. In the absence of a reasonable objection from that State Party within one month, the State Party applied to may consider the application on its merits and decide upon it.
- 34.3. If the State Party applied to considers that, notwithstanding an objection under paragraph 2, the application ought nonetheless to be approved, it shall refer the application to the Council for a decision.

34.4. In dealing with applications under this Article, States Parties and the Council shall take into account:

- (a) the principles set out in Article 3;
- (b) their respective obligations under the United Nations Convention on the Law of the Sea and under any Convention in force related thereto;
- (c) in the case of living marine resources, any determination by the Council of the allowable catch within the Zone for the period in question.

34.5. A person to whom permission to engage in a non-petroleum development activity in the Zone is given under this Article may carry out that activity, subject to the laws of the authorising State Party and to its exclusive administration.

#### **ARTICLE 35: INFORMATION AND MONITORING**

35.1. Each State Party shall, through the Authority, periodically inform the other of the outcome of applications made, whether by nationals or non-nationals, in respect of non-petroleum development activity in the Zone.

35.2. The Authority may request further information as to the consequences of development activities carried out pursuant to this Part. The States Parties shall comply with all reasonable requests in this regard.

## **PART TEN: MISCELLANEOUS**

### **ARTICLE 36: EMPLOYMENT AND TRAINING**

- 36.1. The Authority may issue guidelines in respect of the employment and training policies to be followed by contractors in the Zone for the purposes of:
- (a) enhancing the employment opportunities of nationals of the States Parties consistent with the safe and efficient conduct of petroleum and other development activities;
  - (b) assisting to the extent practicable the equitable division of employment and training benefits between the States Parties.
- 36.2. The terms of development contracts shall comply with such guidelines.
- 36.3. The States Parties shall co-operate in the administration of their immigration and employment laws so as to facilitate the issue of visas and work permits for the purposes of development contracts in relation to the Zone.

### **ARTICLE 37: HEALTH AND SAFETY**

- 37.1. The Authority shall take all reasonable steps to secure the health and safety of personnel engaged in development activities and the safety of the installations and pipelines in the Zone, and shall promptly propose to the Council, for adoption as part of the applicable law, laws, regulations and guidelines for health and safety in relation to off-shore development activity.
- 37.2. The States Parties shall, on the recommendation of the Authority, adopt administrative procedures for the exchange of information concerning the matters referred to in paragraph 1.

## **ARTICLE 38: PREVENTION OF POLLUTION AND PROTECTION OF THE MARINE ENVIRONMENT**

- 38.1. The Authority shall take all reasonable steps to ensure that development activities in the Zone do not cause or create any appreciable risk of causing pollution or other harm to the marine environment.
- 38.2. In accordance with paragraph 1, the States Parties on the recommendation of the Authority shall agree necessary measures and procedures to prevent and remedy pollution of the marine environment resulting from development activities in the Zone.
- 38.3. In order to facilitate the effective monitoring of the environmental impact of petroleum activities in the Zone both States Parties shall regularly provide the Authority with such relevant information as they obtain from contractors or inspectors concerning levels of petroleum discharge and contamination. In particular the States Parties shall immediately inform the Authority of the occurrence of the following events:
- (a) any petroleum spillage or event likely to cause pollution and requiring remedial measures beyond the capacity of the operator;
  - (b) discharge into the sea of large quantities of petroleum from an installation or pipeline;
  - (c) collisions at sea involving damage to an installation or pipeline;
  - (d) evacuation of personnel from an installation due to force majeure, distress or other emergency.

The notification shall include any measures taken or proposed with respect to such events.

- 38.4. Nothing in this Treaty shall prejudice the taking or enforcement by each State Party or by the States Parties jointly of measures in the Zone proportionate to the actual or threatened damage to protect their coastline or exclusive maritime areas from pollution or threat of pollution which may reasonably be expected to result in major harmful consequences.

## **ARTICLE 39: APPLICABLE PRIVATE LAW**

In accordance with Article 3, the Authority shall propose to the Council for immediate adoption as part of the applicable law, to the extent that the private law of the Zone is not determined by or pursuant to other parts of this Treaty, the private law of one of the States Parties.

## **ARTICLE 40: CRIMINAL LAW AND JURISDICTION**

- 40.1. Subject to paragraph 3 of this Article a national or permanent resident of a State Party shall be subject to the criminal law of that State Party in respect of acts or omissions occurring in the Zone provided that a permanent resident of a State Party who is a national of the other State Party shall be subject to the criminal law of the latter State Party. A national of both States Parties shall be subject to the criminal law of both.
- 40.2. A national of a third State, not being a permanent resident of either State Party, shall be subject to the criminal law of both States Parties in respect of acts or omissions occurring in the Zone. Such a person shall not be subject to criminal proceedings under the law of one State Party if he or she has already been tried and discharged or acquitted by a competent tribunal or already undergone punishment for the same act or omission under the law of the other State Party.
- 40.3. The States Parties shall provide assistance to and co-operate with each other including through agreements or arrangements as appropriate, for the purposes of enforcement of criminal law under this Article, including the obtaining of evidence and information.
- 40.4. Each State Party recognises the interest of the other where a victim of an alleged offence is a national of that other State Party, and shall keep that other State Party informed to the extent permitted by its law of action being taken with regard to the alleged offence.
- 40.5. A State Party may make arrangements permitting officials of the other State Party to assist in the enforcement of the criminal law of the first State Party. Where such

assistance involves the detention by the other State Party of a person who under the foregoing provisions of this Article is subject to the jurisdiction of the first State Party, that detention may continue only until it is practicable to hand the person over to the relevant officials of the first State Party.

- 40.6. This Article is without prejudice to any other basis for the exercise of the criminal jurisdiction of either of the States Parties.

#### **ARTICLE 41: COMPLIANCE AND ENFORCEMENT**

- 41.1. Development activities in the Zone shall be carried on in accordance with the relevant applicable law.
- 41.2. The States Parties shall take all appropriate measures within their national legal systems to enforce the applicable law.
- 41.3. The States Parties shall render all necessary and reasonable assistance and support in ensuring that contractors comply with the applicable law.

#### **ARTICLE 42: CIVIL AND ADMINISTRATIVE JURISDICTION**

- 42.1. Unless otherwise provided in this Treaty, each of the States Parties may exercise civil or administrative jurisdiction in relation to development activities in the Zone, or persons present in the Zone for the purposes of those activities, to the same extent as they may do so in relation to activities and persons in their own exclusive economic zone.
- 42.2. In the exercise of jurisdiction under paragraph 1, the States Parties shall give effect to the relevant applicable law.
- 42.3. This Article is without prejudice to any other basis for the exercise of civil or administrative jurisdiction by either of the States Parties.

#### **ARTICLE 43: SECURITY AND POLICING IN THE ZONE**

- 43.1. The States Parties shall to the extent from time to time appropriate having regard to the purposes of this Treaty and their respective defence and police needs, jointly conduct defence or police activities throughout the Zone (in the case of police activities for the purposes of enforcing the applicable law), except to the extent that the Council may from time to time otherwise direct. The costs of such activities shall be borne by the States Parties in the proportions set out in paragraph 1 of Article 3.

- 43.2. If and to the extent that either State Party shall fail to comply with its obligations set out in paragraph 1 or otherwise refuse to participate in proposed joint defence or police activities then without prejudice to any other rights the other State Party may have, nothing in this Treaty shall prevent that other State Party from separately carrying on such activities to such extent as it considers necessary or appropriate.
- 43.3. The States Parties shall consult with each other as required with a view to ensuring the effective and orderly enforcement of this Treaty and the security of the Zone for the purposes of development activities, ongoing or proposed.
- 43.4. This Article is without prejudice to any other basis for the conduct of defence or police activities which either State Party may have under international law.

#### **ARTICLE 44: REVIEW OF APPLICABLE LAW AND ENFORCEMENT ARRANGEMENTS**

The Authority may at any time recommend to the Council any changes in the applicable law or in the arrangements for its enforcement, to the extent that these may be necessary.

#### **ARTICLE 45: RIGHTS OF THIRD STATES**

- 45.1. In the exercise of their rights and powers under this Treaty, the States Parties shall take into account the rights and freedoms of other States in respect of the Zone as provided under generally accepted principles of international law.
- 45.2. If any third party claims rights inconsistent with those of the States Parties under this Treaty then the States Parties shall consult through appropriate channels with a view to co-ordinating a response.

#### **ARTICLE 46: POSITION OF THIRD PERSONS IN RELATION TO THE ZONE**

- 46.1. The States Parties shall co-operate with a view to resolving in an equitable manner as between themselves any issues arising in respect of prior dealings by either State

Party with any third person in respect of any part of the Zone that have been disclosed to the other State Party in the course of negotiating the present Treaty.

- 46.2. However, in respect of any matter not disclosed by a State Party to the other State Party in the course of the negotiation of the present Treaty, it shall be a matter for the non-disclosing State Party alone, without any right to the co-operation or assistance of the other State Party, to resolve any issues arising in respect of prior dealings by it with any third person in respect of any part of the Zone.

**PART ELEVEN: RESOLUTION OF DEADLOCKS AND SETTLEMENT OF  
DISPUTES**

**ARTICLE 47: SETTLEMENT OF DISPUTES BETWEEN THE AUTHORITY AND PRIVATE  
INTERESTS**

- 47.1. Disputes between the Authority and a contractor or between joint contractors and/or operators concerning the interpretation or application of a development contract or operating agreement, shall unless otherwise agreed between the parties thereto be subject to binding commercial arbitration pursuant to the terms of the relevant development contract or operating agreement.
- 47.2. Unless otherwise agreed, the arbitration shall be held in Lagos pursuant to the UNCITRAL Arbitration Rules and administered by the AACCL Centre for International Commercial Dispute Settlement, Lagos.
- 47.3. The Authority shall be immune from suit in any court in respect of the merits of any dispute referable to arbitration in accordance with paragraph 1.

**ARTICLE 48: RESOLUTION OF DISPUTES ARISING IN THE WORK OF THE  
AUTHORITY OR THE COUNCIL**

- 48.1. Any dispute that arises with respect to the functioning of this Treaty shall be sought to be resolved by the Board having regard to the objects and purposes of this Treaty, the principles set out in Article 3 and the spirit of amicable fraternal relations between the two States Parties.
- 48.2. If a dispute cannot be resolved by the Board and its continuance affects or threatens to affect the actual or future implementation of this Treaty, it shall be referred to the Council.
- 48.3. The Council shall make every effort to resolve the dispute in a spirit of compromise, and without prejudice to any underlying position of either State Party.

- 48.4. If the dispute has not been resolved by the Council within 12 months of being referred to the Council under paragraph 2, or such other period as the Heads of State may decide, the Council or either State Party may refer it to the Heads of State for their decision.

#### **ARTICLE 49: SETTLEMENT OF UNRESOLVED DISPUTES BETWEEN THE STATES PARTIES**

- 49.1. The provisions of Article 52 shall apply
- (a) if the Heads of State agree in writing that a dispute referred to them under paragraph 48 concerns a matter of policy or administration and the dispute has not been resolved by the Heads of State within 12 months of its referral to them, or such additional time as they agree; or
  - (b) if arbitral proceedings under paragraph 2 below leave a substantial dispute between the parties unresolved by reason, either expressly or implicitly, of the fact that such dispute concerns a matter of policy or administration.
- 49.2. In any case not covered by sub-paragraph 1 (a), if the dispute has not been resolved by the Heads of State within six months of the reference under paragraph 4 of Article 48, and unless the States Parties have otherwise agreed, either State Party may give notice to the other State Party (the "referral") to refer the dispute to an arbitral tribunal ("the Tribunal") for resolution.
- 49.3. The Tribunal shall be constituted in the following manner:
- (a) Each State Party shall, within 60 days of the referral, appoint one arbitrator and the two arbitrators so appointed shall within 60 days of the appointment of the second arbitrator appoint a national of a third State as third arbitrator who shall act as President of the Tribunal;
  - (b) If a State Party fails to appoint an arbitrator within 60 days of the referral, or the two arbitrators fail to appoint a third arbitrator within 60 days of the appointment of the second, either State Party may request the President of

the International Court of Justice to fill the vacancy by appointing a national of a third State;

- (c) If the President of the International Court of Justice is a national of or habitually resident in the territory of a State Party or is otherwise unable to act, the appointment shall be made by the next most senior judge of the Court who is not a national of either State Party and who is available to act;
- (d) The Tribunal shall apply the UNCITRAL Rules, and on any point not covered by those Rules shall determine its own procedure, unless the States Parties have otherwise agreed;
- (e) The Tribunal pending its final award may on the request of a State Party issue an order or orders indicating the interim measures which must be taken to preserve the respective rights of either State Party or prevent the aggravation or extension of the dispute;
- (f) Unless the States Parties otherwise agree, the Tribunal shall sit at The Hague and the administering authority for the arbitration shall be the Secretariat of the Permanent Court of Arbitration.

49.4. Decisions of the Tribunal shall be final and binding on the States Parties.

49.5. The States Parties shall carry out in good faith all decisions of the Tribunal including any orders for interim measures. Any question as to the implementation of a decision may be referred to the Tribunal, or if the same tribunal is no longer in existence and cannot be reconstituted, to a new Tribunal constituted in accordance with paragraph 3.

## **PART TWELVE: ENTRY INTO FORCE AND OTHER MATTERS**

### **ARTICLE 50: ENTRY INTO FORCE**

- 50.1. This Treaty shall enter into force on the exchange of instruments of ratification by both States Parties.
- 50.2. Within three months of the exchange of ratifications, each State Party shall procure the enactment by its own constitutional processes of any legislation or regulations necessary to implement this Treaty in its legal system. The text of any such legislation or regulations shall be promptly forwarded to the other State Party.
- 50.3. Upon entry into force, this Treaty shall be registered with the Secretary-General of the United Nations.

### **ARTICLE 51: DURATION AND TERMINATION**

- 51.1. This Treaty shall, be reviewed by the States Parties in year thirty (30), and unless otherwise agree or terminated pursuant to Article 52, shall remain in force for forty-five (45) years from the date of entry into force.
- 51.2. If the two States Parties agree, this Treaty shall be continued in force after the initial forty-five (45) year term.
- 51.3. Unless otherwise agreed, the expiry or other termination of this Treaty shall not affect development contracts with an expiry date after such expiry or other termination and the provisions of this Treaty shall remain in force for the sole purpose of administering such contracts and maintaining the joint development regime to the extent necessary. On the expiry or earlier termination of the last remaining such contract the outstanding provisions of this Treaty shall terminate forthwith.
- 51.4. Accordingly, unless the States Parties otherwise agree, the Council and the Authority shall, following expiry or other termination of this Treaty, continue to exercise such

residual functions as may be necessary in respect of the continuing administration of existing development contracts, and shall continue in being for that purpose.

- 51.5. Unless the States Parties otherwise agree, such expiry or other termination shall not affect the financial rights and obligations of the States Parties accrued under or pursuant to this Treaty prior to expiry or termination.

## **ARTICLE 52: SPECIAL PROVISION FOR TERMINATION IN CERTAIN CASES**

52.1. This Article applies:

- (a) in any case of a dispute which falls under paragraph 1 of Article 49;
- (b) in any case in which a State Party remains for more than 180 days in material breach of an award by a tribunal constituted pursuant to Article 49.

52.2. In the case referred to in sub-paragraph 1 (a) of this Article 52, either State Party may give six months notice of termination of this Treaty, and in the case referred to in sub-paragraph 1 (b) the aggrieved State Party may do so.

**ARTICLE 53: LANGUAGE OF TREATY**

This Treaty is executed in the English and Portuguese languages, both versions having equal authority.

**IN WITNESS WHEREOF** the undersigned, being duly authorised thereto by their respective Governments, have signed this Treaty.

Done at Abuja the 21<sup>st</sup> day of February 2001

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**Hon. Dubem Onyia**  
**Minister of State for Foreign Affairs**

**for the Government of**  
**the Federal Republic of Nigeria**

-----  
**Hon. Joaquim Rafael Branco**  
**Minister for Foreign Affairs**  
**and Cooperation**  
**for the Government of**  
**the Democratic Republic of São Tomé**  
**e Príncipe**

## APPENDIX

### SPECIAL REGIME AREA

1. The Special Regime Area is as follows:
  - (a) the approximately triangular area of the sea which is bounded by lines joining the following points using the WGS 84 Datum in the order listed:  
  

A: 3° 00' 28" N, 6° 57'16" E  
B: 2° 56' 23" N, 6° 57'17" E  
C: 2° 56' 22" N, 6° 43'27" E

the lines from A to B and B to C being lines of constant bearing and the line from A to C following the north-west edge of the Zone; and
  - (b) the seabed, subsoil and the superjacent waters thereof.
2. Notwithstanding any other provision of this Agreement, Nigeria shall throughout the duration of this Agreement have the exclusive right to administer the Special Regime Area and exercise jurisdiction over it, including the right to exploit and develop its resources for its own benefit.
3. Nigeria will safeguard the interest of São Tomé e Príncipe by undertaking some development projects which will be governed by a separate Memorandum of Understanding that will form an integral part of this Treaty. The provisions of this Memorandum of Understanding are without prejudice to any other arrangements in the future that will enhance the joint co-operation between the two countries.

# **Appendix Two**

**Interview and Interview Information Sheet**

# Interview Questions

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## Survey I: The management structure

- This section of the survey is designed to collect information regarding your organisation's management structure in relation to marine fisheries management.
1. Please explain briefly the role of your organisation in the overall management of fisheries within the JDZ?
  2. Please explain briefly how your organisation fits in within the management structure for the marine fisheries resources of the JDZ?
  3. Please explain briefly how long you have been involved with the implementation of your organisation's fisheries management and in what capacity?
  4. Please explain briefly how the JDZ fisheries resources are monitored or inspected by your organisation and the frequency?
  5. Please state which departments in your organisation are most directly involved with the JDZ marine fisheries management?

## Survey II: Management policies adopted for the JDZ fishery

- **This section of the survey is designed to collect information on the conceptualisation and design of management policies in place for the sustainability of marine fisheries.**
6. Please state briefly your organisation's policies for fisheries in the JDZ?
  7. Please explain briefly the objectives of your organisation's policies for fisheries in the JDZ?
  8. Please briefly explain the processes and procedures followed for the adoption of your organisation's JDZ fisheries management policies?
  9. Please state how your organisation's fisheries policies converge with or diverge from other stakeholders' fisheries policies for the JDZ?
  10. In your own opinion, please identify the areas of marine fisheries management you think your organisation has been most effective at?
  11. In your own opinion, please identify areas of marine fisheries management you think your organisation has been ineffective at?

### **Survey III: Nature of fishing within the JDZ**

- **This section of the survey is designed to collect information on the nature of JDZ fishing and the management regime in place to sustainably manage it.**
12. Please indicate briefly the sort of fisheries management regimes in existence within the JDZ?
  13. Please identify any other legitimate practitioners and official bodies responsible for the management regime(s) in place within the JDZ?
  14. Please explain briefly whether a licensing or quota system for marine fisheries resources operates in the JDZ?
  15. Please state briefly your organisation's involvement with the processes and procedures for granting such licenses or quota to the JDZ fisheries resources?
  16. Please explain briefly any other management measures put in place and contributed by your organisation to ensure sustainable marine fisheries management within the JDZ?
  17. Please state which other relevant stakeholders you believe should be involved in marine fisheries management within the JDZ?

### **Survey IV: Nature of IUU fishing around the JDZ**

- **This section of the survey is designed to collect information on the particular issue of Illegal, Unreported and Unregulated (IUU) fishing and the management strategies put in place to manage it.**

18. In your own view, please identify the major sources of IUU fishing within the JDZ stating which flag states are involved, the type of fishing engaged and the species targeted?
19. In your own opinion, please state what percentage and type of fishing within the JDZ suffers due to IUU fishing?
20. Please state what other organisations/parties/interests you believe are involved /engaged in the management, downstream trading and handling of IUU fish catches within the JDZ?
21. Please explain briefly the role of your organisation in managing IUU fishing within the JDZ and what (if any) approaches it uses?
22. Please explain what form of technology (if any) is being used or employed currently in tackling/ curbing/ managing IUU fishing within the JDZ by your organisation?
23. Please briefly explain how your organisation's IUU fishing management strategies relate to other stakeholders' IUU fishing management strategies within the JDZ?
24. Please state which other people and organisations (that you have not mentioned previously) are involved in the management of IUU fishing within the JDZ. For any mentioned, I would be grateful if you could also suggest the best way to contact them?

25. In your own opinion, please state how IUU fishing management strategies can best be improved by your organisation within the JDZ?

### Survey V: Level of awareness/employment of indicator

- **This section of the survey is designed to collect information on the use, knowledge and employment of indicators for the assessment and management of the sustainability of marine fisheries within the JDZ. *'Indicators'* may be defined as 'tools or instruments that may be used to provide information about the state of coastal and marine ecosystems so as to promote a better understanding towards the communication and evaluation of environmental processes and policies'.**

26. Please state whether a sustainability agenda for marine fisheries resources exists for the JDZ in line with the objectives of Agenda 21, and if so, how your organisation implements it?

27. Please explain whether an indicator-based sustainability assessment has been previously tried/ employed for JDZ fisheries by your organisation?

28. Please state the sort of indicators (if any) your organisation has employed to measure/ assess the sustainability of marine fisheries within the JDZ?

29. Please briefly explain the measures put in place (if any) by your organisation to ensure an indicator-based marine fisheries management/ assessment within the JDZ?

30. Please explain whether your organisation is involved in liaising/ working with other stakeholders to develop or use indicator-based marine fisheries sustainability assessment/ management within the JDZ?

Thank you very much for taking the time to respond to this questionnaire; your opinion is highly valued. I would be very grateful to come and receive them in person, but where this becomes impossible please feel free to send them to any of the following addresses below: -

Aliyu Hamza Dan'Agalan

PhD. Student,  
Department of Geography,  
Faculty of Science,  
University of Portsmouth, Buckingham Building  
Lion Terrace, Portsmouth  
United Kingdom  
PO1 3HE  
E-mail: [aliyu.danagalan@port.ac.uk](mailto:aliyu.danagalan@port.ac.uk) and [ahdanagalan@yahoo.com](mailto:ahdanagalan@yahoo.com)  
Mobile Number: +447774286819, +2348034537929.

OR

Dr Jonathan Potts (Research First Supervisor)  
Senior Lecturer  
Department of Geography, Faculty of Science  
University of Portsmouth, Buckingham Building  
Lion Terrace, Portsmouth  
United Kingdom  
PO1 3HE  
E-mail: [jonathan.potts@port.ac.uk](mailto:jonathan.potts@port.ac.uk)



# Interview Participant Information Sheet

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## **The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone**

My name is Aliyu Hamza Dan'Agalan, an employee of the Nigeria's National Boundary Commission and currently a PhD student in the Department of Geography of the Faculty of Science at the University of Portsmouth. My research is investigating the use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ).

You have been chosen to take part in the study based on your wealth of experience and relevance. Your opinion on the topic is highly regarded. As part of the data collection required for my research, I would be very grateful if you would consider participating in the interview survey. However, before you decide to take part in the study, it is important that you have an overview of what the research entails and also know how important your cooperation is to the study. You are welcome to discuss your participation with others and to seek further clarification from myself on any aspect of your participation that is not clear. Please spare some time to read the following information carefully.

In 1999, the officials of the Nigeria's and Sao Tome & Principe's governments embarked upon delineating their maritime boundary. They found that the two nations' maritime boundaries overlapped as a result of establishing their Exclusive Economic Zones (EEZ).

This area of overlap was found to have enormous potential in terms of hydrocarbon and non-hydrocarbon resources. Several meetings and negotiations ensued and the area of overlap was designated a joint development zone (JDZ). A treaty was signed in 2001 for the joint exploration of these resources by the two countries. The JDZ is a marine area that is situated within the Guinea Current Large Marine Ecosystem (GCLME)-an ecologically rational unit of ocean space and one of the 64 globally delineated LMEs-around the Gulf of Guinea.

Internationally, nation states that have overlapping claims over offshore transboundary marine resources are encouraged to enter into a joint development arrangement over such resources for their mutual benefit. This is supported by the objectives of chapter 17, Agenda 21 of the United Nations Conference on Environment and Development (UNCED) which promotes sustainable, integrated use and management of marine living resources of the EEZ, high seas and under national jurisdictions.

The aim of the research is to: evaluate the effectiveness and sustainability of fisheries management in the light of Illegal, Unregulated and Unreported (IUU) fishing; evaluate the current and potential use of the Transboundary Waters Assessment Programme-Large Marine Ecosystem TWAP LME indicators to improve that management; and explore the challenges that IUU fishing pose for the use of the indicators given the characteristics of the JDZ and particularly the extent of IUU fishing around the area.

The interview is specifically designed for you as a senior management official within your organisation and other carefully selected senior management committee members of other related organisations that are directly or indirectly related to the sustainable management of the shared marine fishery resources within the JDZ in particular and the Gulf of Guinea in general.

The questions contained in the interview should not take a significant amount of time to complete. The response format is open-ended so that you have free choice of, and can elaborate on, your answers.

Please may I request your permission to record the interview to ensure the accuracy of record taking and to also solicit your cooperation in conducting the interview as soon as

reasonably practicable? The latter will enable me to proceed with the analysis and presentation of results in good time.

Please note that where possible, your responses to this interview will be kept anonymous. If this is not possible, you will be sent a transcript of the material to be cited for your prior approval. If you are willing to have your comments attributed, please let me know using the appropriate boxes on the consent form. Once analysed, the results will be integrated into my PhD and hopefully, published in academic journals.

A consent form is hereby enclosed for your completion as appropriate in relation to your willingness and acceptance should you decide to participate. Should you require a copy of the results or any further information regarding the research, please do not hesitate to contact me using the following contact details.

Thank you for your attention and anticipated cooperation.

Kind regards.

Aliyu Hamza Dan'Agalan

PhD. Student, Department of Geography,  
Faculty of Science,  
University of Portsmouth  
E-mail: [aliyu.danagalan@port.ac.uk](mailto:aliyu.danagalan@port.ac.uk) and [ahdanagalan@yahoo.com](mailto:ahdanagalan@yahoo.com)  
Mobile Number: +447774286819, +2348034537929.

OR

Dr Jonathan Potts (Research First Supervisor)  
Senior Lecturer  
Department of Geography, Faculty of Science  
University of Portsmouth, Buckingham Building  
Lion Terrace, Portsmouth  
United Kingdom  
PO1 3HE  
E-mail: [jonathan.potts@port.ac.uk](mailto:jonathan.potts@port.ac.uk)

# **Appendix Three**

## **Questionnaire and Questionnaire Information Sheet**

# Questionnaire Survey



- Please note that you may wish to expand your comments on a separate sheet of paper should the available spaces become insufficient. Alternatively, if the answers already exist in documentary form, please feel free to cross-reference to and enclose such documents.

Name of Organisation: -

Name:-

Position:-

Department:-

E-mail:-

## Survey I: The management structure

- **This section of the survey is designed to collect information regarding your organisation's management structure in relation to marine fisheries management.**

1. Please explain briefly the role of your organisation in the overall management of fisheries within the JDZ?

2. Please explain briefly how your organisation fits in within the management structure for the marine fisheries resources of the JDZ?

3. Please explain briefly how long you have been involved with the implementation of your organisation's fisheries management and in what capacity?

4. Please explain briefly how the JDZ fisheries resources are monitored or inspected by your organisation and the frequency?

5. Please state which departments in your organisation are most directly involved with the JDZ marine fisheries management?

## Survey II: Management policies adopted for the JDZ fishery

- This section of the survey is designed to collect information on the conceptualisation and design of management policies in place for the sustainability of marine fisheries.

6. Please state briefly your organisation's policies for fisheries in the JDZ?

7. Please explain briefly the objectives of your organisation's policies for fisheries in the JDZ?

8. Please briefly explain the processes and procedures followed for the adoption of your organisation's JDZ fisheries management policies?

9. Please state how your organisation's fisheries policies converge with or diverge from other stakeholders' fisheries policies for the JDZ?

10. In your own opinion, please identify the areas of marine fisheries management you think your organisation has been most effective at?

11. In your own opinion, please identify areas of marine fisheries management you think your organisation has been ineffective at?

### Survey III: Nature of fishing within the JDZ

- **This section of the survey is designed to collect information on the nature of JDZ fishing and the management regime in place to sustainably manage it.**

12. Please indicate briefly the sort of fisheries management regimes in existence within the JDZ?

13. Please identify any other legitimate practitioners and official bodies responsible for the management regime(s) in place within the JDZ?

14. Please explain briefly whether a licensing or quota system for marine fisheries resources operates in the JDZ?

15. Please state briefly your organisation's involvement with the processes and procedures for granting such licenses or quota to the JDZ fisheries resources?

16. Please explain briefly any other management measures put in place and contributed by your organisation to ensure sustainable marine fisheries management within the JDZ?

17. Please state which other relevant stakeholders you believe should be involved in marine fisheries management within the JDZ?

### Survey IV: Nature of IUU fishing around the JDZ

- This section of the survey is designed to collect information on the particular issue of Illegal, Unreported and Unregulated (IUU) fishing and the management strategies put in place to manage it.

18. In your own view, please identify the major sources of IUU fishing within the JDZ stating which flag states are involved, the type of fishing engaged and the species targeted?

19. In your own opinion, please state what percentage and type of fishing within the JDZ suffers due to IUU fishing?

20. Please state what other organisations/parties/interests you believe are involved /engaged in the management, downstream trading and handling of IUU fish catches within the JDZ?

21. Please explain briefly the role of your organisation in managing IUU fishing within the JDZ and what (if any) approaches it uses?

22. Please explain what form of technology (if any) is being used or employed currently in tackling/ curbing/ managing IUU fishing within the JDZ by your organisation?

23. Please briefly explain how your organisation's IUU fishing management strategies relate to other stakeholders' IUU fishing management strategies within the JDZ?

24. Please state which other people and organisations (that you have not mentioned previously) are involved in the management of IUU fishing within the JDZ. For any mentioned, I would be grateful if you could also suggest the best way to contact them?

25. In your own opinion, please state how IUU fishing management strategies can best be improved by your organisation within the JDZ?

## Survey V: Level of awareness/employment of indicator

- **This section of the survey is designed to collect information on the use, knowledge and employment of indicators for the assessment and management of the sustainability of marine fisheries within the JDZ. *'Indicators'* may be defined as 'tools or instruments that may be used to provide information about the state of coastal and marine ecosystems so as to promote a better understanding towards the communication and evaluation of environmental processes and policies'.**

26. Please state whether a sustainability agenda for marine fisheries resources exists for the JDZ in line with the objectives of Agenda 21, and if so, how your organisation implements it?

27. Please explain whether an indicator-based sustainability assessment has been previously tried/ employed for JDZ fisheries by your organisation?

28. Please state the sort of indicators (if any) your organisation has employed to measure/ assess the sustainability of marine fisheries within the JDZ?

29. Please briefly explain the measures put in place (if any) by your organisation to ensure an indicator-based marine fisheries management/ assessment within the JDZ?

30. Please explain whether your organisation is involved in liaising/ working with other stakeholders to develop or use indicator-based marine fisheries sustainability assessment/ management within the JDZ?

Thank you very much for taking the time to respond to this questionnaire; your opinion is highly valued. I would be very grateful to come and receive them in person, but where this becomes impossible please feel free to send them to any of the following addresses below: -

Aliyu Hamza Dan'Agalan

PhD. Student,  
Department of Geography,  
Faculty of Science,  
University of Portsmouth, Buckingham Building  
Lion Terrace, Portsmouth  
United Kingdom  
PO1 3HE  
E-mail: [aliyu.danagalan@port.ac.uk](mailto:aliyu.danagalan@port.ac.uk) and [ahdanagalan@yahoo.com](mailto:ahdanagalan@yahoo.com)  
Mobile Number: +447774286819, +2348034537929.

OR

Dr Jonathan Potts (Research First Supervisor)  
Senior Lecturer  
Department of Geography, Faculty of Science  
University of Portsmouth, Buckingham Building  
Lion Terrace, Portsmouth  
United Kingdom  
PO1 3HE  
E-mail: [jonathan.potts@port.ac.uk](mailto:jonathan.potts@port.ac.uk)



# Questionnaire Participant Information Sheet

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## **The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone**

My name is Aliyu Hamza Dan'Agalan, an employee of the Nigeria's National Boundary Commission and currently a PhD student in the Department of Geography of the Faculty of Science at the University of Portsmouth. My research is investigating the use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ).

You have been chosen to take part in the study based on your wealth of experience and relevance. Your opinion on the topic is highly regarded. As part of the data collection required for my research, I would be very grateful if you would consider participating in the enclosed survey. However, before you decide to take part in the study, it is important that you have an overview of what the research entails and also know how important your cooperation is to the study. You are welcome to discuss your participation with others and to seek further clarification from myself on any aspect of your participation that is not clear. Please spare some time to read the following information carefully.

In 1999, the officials of the Nigeria's and Sao Tome & Principe's governments embarked upon delineating their maritime boundary. They found that the two nations' maritime boundaries overlapped as a result of establishing their Exclusive Economic Zones (EEZ).

This area of overlap was found to have enormous potential in terms of hydrocarbon and non-hydrocarbon resources. Several meetings and negotiations ensued and the area of

overlap was designated a joint development zone (JDZ). A treaty was signed in 2001 for the joint exploration of these resources by the two countries. The JDZ is a marine area that is situated within the Guinea Current Large Marine Ecosystem (GCLME)-an ecologically rational unit of ocean space and one of the 64 globally delineated LMEs around the Gulf of Guinea.

Internationally, nation states that have overlapping claims over offshore transboundary marine resources are encouraged to enter into a joint development arrangement over such resources for their mutual benefit. This is supported by the objectives of chapter 17, Agenda 21 of the United Nations Conference on Environment and Development (UNCED) which promotes sustainable, integrated use and management of marine living resources of the EEZ, high seas and under national jurisdictions.

The aim of the research is to: evaluate the effectiveness and sustainability of fisheries management in the light of Illegal, Unregulated and Unreported (IUU) fishing; evaluate the current and potential use of the Transboundary Waters Assessment Programme-Large Marine Ecosystem TWAP LME indicators to improve that management; and explore the challenges that IUU fishing pose for the use of the indicators given the characteristics of the JDZ and particularly the extent of IUU fishing around the area.

The enclosed questionnaire is specifically designed for the members of your organisation and other carefully selected related organisations that are directly or indirectly related to the sustainable management of the shared marine fishery resources within the JDZ in particular and the Gulf of Guinea in general.

The questions contained in this questionnaire should not take a significant amount of time to complete. The response format is open-ended so that you have free choice of, and can elaborate on, your answers. Feel free to expand on a separate piece of paper (including the question number at the top) if you need more space.

May I also request the return of the completed questionnaires as soon as reasonably practicable to enable me to proceed with the analysis and presentation of results in good time?

Please note that where possible, your responses to this questionnaire will be kept anonymous. If this is not possible, you will be sent a transcript of the material to be cited for your prior approval. If you are willing to have your comments attributed, please let me know using the appropriate boxes on the consent form. Once analysed, the results will be integrated into my PhD and hopefully, published in academic journals. Should you require a copy of the results or any further information regarding the research, please do not hesitate to contact me using the following contact details.

Thank you for your attention and anticipated cooperation.

Kind regards.

Aliyu Hamza Dan'Agalan

PhD. Student, Department of Geography,  
Faculty of Science,  
University of Portsmouth  
E-mail: [aliyu.danagalan@port.ac.uk](mailto:aliyu.danagalan@port.ac.uk) and [ahdanagalan@yahoo.com](mailto:ahdanagalan@yahoo.com)  
Mobile Number: +447774286819, +2348034537929.

OR

Dr Jonathan Potts (Research First Supervisor)  
Senior Lecturer  
Department of Geography, Faculty of Science  
University of Portsmouth, Buckingham Building  
Lion Terrace, Portsmouth  
United Kingdom  
PO1 3HE  
E-mail: [jonathan.potts@port.ac.uk](mailto:jonathan.potts@port.ac.uk)

# **Appendix Four**

## **Consent Form**

# Consent Form

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Department of Geography,  
Buckingham Building,  
Lion Terrace,  
Portsmouth  
PO1 3HE  
Researcher:  
Aliyu Hamza Dan'Agalan  
aliyu.danagalan@port.ac.uk  
Supervisor: Dr Jonathan Potts  
Jonathan.potts@port.ac.uk

**Study Title:** The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Authority.

**REC Ref No.:** SFEC/2013/27/130813

**Name of Researcher:** Aliyu Hamza Dan'Agalan

1. I can confirm that I have read and understood the information sheet dated 24<sup>th</sup> June, 2013 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that my participation in the survey is voluntary and that I am free to withdraw at any time without giving any reason provided the data provided has not been analysed.
3. I understand that data collected during the study may be looked at by individuals from University of Portsmouth and I give permission for these individuals to have access to my data.
4. I agree/ disagree to my interview being audio/ video recorded.
5. I agree/ disagree to being quoted verbatim.
6. I agree/ disagree to being named participant and quoted verbatim.
7. I agree to take part in the above study.

Name of Participant:

Date:

Signature:

Name of Person taking consent:

Date:

Signature:

# **Appendix Five**

**Ethics committee favourable opinion**



Faculty of Science  
University of Portsmouth  
St Michael's Building  
White Swan Road  
PORTSMOUTH  
PO1 2DT

Aliyu Hamza Dan'Agalan  
Department of Geography  
Date 13<sup>th</sup> August 2013

**FAVOURABLE OPINION**

**Protocol Title:** The use of selected indicators to examine marine fishery sustainability within the Nigeria Sao Tome & Principe Joint Development Zone (JDZ).

**Date Reviewed:** First review 22<sup>nd</sup> July 2013, Second review 12<sup>th</sup> August 2013

Dear Aliyu,

Thank you for resubmitting your protocol for ethical review and for the clarifications provided.

Your responses have been reviewed and I am pleased to inform you that your application has been given a favourable opinion by the Science Faculty Ethics Committee. Please notify us in the future of any substantial amendments that may be required and send us a final study report.

Good luck with the study.

A handwritten signature in black ink that reads 'Malcolm Bray'.

*Dr Malcolm Bray*  
Geography Dept. Science Faculty Ethics Committee

CC -  
*Dr Chris Markham – Chair of SFEC*  
*Dr Jim House – Vice Chair of SFEC*  
*Jody Salt – Faculty Administrator*

# **Appendix Six**

**Request for feedback and comments document**

The Executive Chairman,  
Nigeria-Sao Tome and Principe Joint Development Authority  
Aminu Kano Crescent,  
Wuse II,  
Abuja.

Department of Geography  
University of Portsmouth  
Buckingham Building  
Lion Terrace  
Portsmouth PO1 3HE  
United Kingdom

T: +44 (0)23 9284 2507  
F: +44 (0)23 9284 2512

9<sup>th</sup> December 2014

Dear Sir,

**Request for feedback and comments based on research outcomes**

You may wish to recall the survey I conducted on your organisation and some other carefully selected stakeholders for my PhD research titled '*The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ)*'.

I have now reached advanced stage of my studies, completed my data analysis and have generated some outcomes based on the analysed survey data. In line with principle of reiterative stakeholder engagement in the development and testing of indicators; I am writing to request your organisation's position on the feasibility of applying those indicators to the JDZ based on the generated outcomes.

Your organisation's feedback and comments is highly valued as the most important stakeholder (the JDZ resource manager) and will be integrated into the PhD to draw conclusions and recommendations capable of improving the JDZ fishery regime and being replicable elsewhere.

Please find enclosed, along with this letter the detailed description of the proposed indicators depicting the current stages and positions of the indicators for your information, tables one and two as well as the information on the feedback and comments expected.

Thank you very much for your attention and anticipated cooperation.

Yours faithfully,



Aliyu Hamza Dan'Agalan  
PhD Candidate

[Aliyu.danagalan@port.ac.uk](mailto:Aliyu.danagalan@port.ac.uk) and [ahdanagalan@yahoo.com](mailto:ahdanagalan@yahoo.com)



## Information on the feedback and comments expected

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### **The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone**

Please recall the survey conducted on your organisation for the purposes of generating data for the above stated research topic. The data generated was analysed and some key observations were made from the results. The summary of the observations are:

- Results from the analyses revealed that the JDA does not have a substantive fishery management regime in place at the moment due to a more inclined interest on hydrocarbons resources even as the treaty explicitly covered marine living resources. It is hoped however, that recommendations and lessons to be learnt from the analyses would contribute towards strengthening the fishery regime since it is in the stage of being developed.
- The fishery management regime of the JDZ as revealed from the analysed data is currently at the stage of being developed and the JDA was found to be in contact with both local and international stakeholders with a view to establishing a substantive fishery regime for the common benefit of the two nations.

Consequently, your feedback and comments are expected to score the Transboundary Waters Assessment Programme-Large Marine Ecosystem (TWAP-LME) indicators the ideal requirements of indicator development namely; availability of data, practicality of implementation, cost-effectiveness, comprehensiveness, robustness and acceptability based

on your current situation as shown in table one attached. You may use ✓ or ✗ to indicate your scores in the table please.

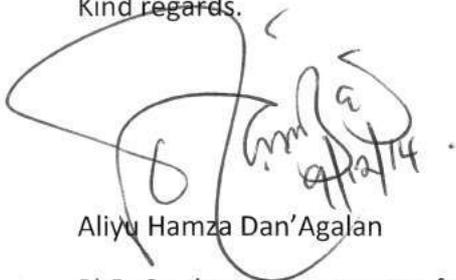
You are also expected score the TWAP-LME indicators against indicator selection criteria namely; your choices of indicators, assigned weight per indicator and a score given to each of the proposed indicators in line with your management and operational objectives as shown in table two. Your choice of an indicator may also be denoted by the ✓ sign, while the weight may be assigned based on three categories of minor, moderate or high and the score can be either 1, 2, 3 or 4 depicting low, fair, moderate and high respectively depending on your organisational situation and operational objectives.

Furthermore, as the research main stakeholder, your comments and feedback based on each choice, score or assigned values will be highly appreciated so that your organisation's positions and standpoint will be fully integrated into the final outcome of the research.

In this regard, it is hoped, recommended and envisaged that you will be able to provide a detailed feedback and comments along with the filled table templates.

Thank you for your attention and anticipated cooperation.

Kind regards.

A handwritten signature in black ink, appearing to read 'Aliyu Hamza Dan'Agalan', with a date '11/2/14' written below it. The signature is written over a large, stylized circular scribble.

Aliyu Hamza Dan'Agalan

PhD. Student, Department of Geography,  
Faculty of Science,  
University of Portsmouth

E-mail: [aliyu.danagalan@port.ac.uk](mailto:aliyu.danagalan@port.ac.uk) and [ahdanagalan@yahoo.com](mailto:ahdanagalan@yahoo.com)

Mobile Number: +447774286819, +2348034537929.

## **Detailed Indicators Description**

### **The productivity module indicator**

The productivity module has 3 main TWAP-LME indicators; namely primary productivity, sea surface temperature and oceanographic fronts.

(1) The primary productivity indicator -one of the indicators that measure ecosystem productivity is used together with chlorophyll a to examine coastal and marine eutrophication and its methodology is derived from satellite-borne data which originate from ocean colour sensors including Coastal Zone Colour Scanner (CZCS), Sea-viewing Wide field of view sensor (SeaWiFS) and Moderate Resolution Imaging Spectroradiometer (MODIS-Aqua and MODIS-Terra). Data for the 64 delineated LMEs could be sourced from the NOAA and University of Rhode Island and are freely accessible online in form of satellite images.

(2) The sea surface temperature indicator-another indicator that measures ecosystem productivity which is useful for detecting variability in ocean temperature trends. Its methodology is based on data computation from the UK meteorological office-Harley centre-from where SST climatology was used to compute 50 year time series of SST trends and anomalies within the global LMEs. Its main relevance is due to its ability to provide meaningful assessment of LMEs heating or cooling. The resulting SST trends for all the 64 LMEs are available online in form of a digital map depicting the temperature status for all the delineated LMEs. There are digital maps showing temperature trends of all the global LMEs on the NOAA website.

(3) The oceanographic fronts-the third indicator within ecosystem productivity module is used for climate change monitoring, prediction and for fishing as well as marine mining industries and their methodology is determined by frontal data archive through the association of SST fronts with chlorophyll fronts and lend themselves to marine physical-biological correlations once digitized. They are relevant in that they affect ecosystem productivity as a zone of enhanced horizontal gradients of physical, chemical and biological properties. The first survey of all the LME fronts was based on the frontal data assembled at the University of Rhode Island and are available on the NOAA website though not easily accessible.

### **The fish and fishery module indicator**

The fish and fishery module has 8 main TWAP-LME indicators; namely the reported landings, value of reported landings, marine trophic index and fish in balance index, ecological footprints of fisheries, stock status plots, fishing efforts, projected catch potential and LME carrying capacity in relation to maximum sustainable yield (MSY).

(1) The reported landings-one of the indicators of fish and fishery module is used for identifying species composition and functional groups. Reported landings are determined by time series of reconstructed landings from 1950-2006 through mapping, developed and reported for each of the LMEs. They are relevant in that they highlight time series catches which indicate fisheries status and trends. Time series data are available online with UBC Sea around us project, FAO and Fish base.

(2) The value of reported landings is another indicator for fish and fishery module that is used to assign real economic value of catches in addition to being a cross modular indicator with strong links to the socio economic module indicator as well as a major stress factor in marine ecosystems. It is computed by using the catch value as the ex-value which is determined by the value of reported landings by LMEs based on real 2000 prices. Currently, global time series (1950-2006) of database for ex vessel fish price data has been constructed and are presented. Time series data are available and easily accessible online on the 'Sea-Around Us' project website and are in time series.

(3) The marine trophic index and fish in balance index (MTI & FIB)-an indicator for the fish and fishery module is developed and used for fish trophic levels which is recognised as the most accurate way of also observing stock depletion. Its methodology is derived from time series data covering from 1950-2006 of MTI and FIB where trophic levels are assigned to all catches per given area and is calculated by weighting the species/group with the corresponding catch level. This indicator indicates changes in the state of ecosystem and its provisioning services occasioned by fishing. Trophic levels data can be obtained from FAO based on the information on fish base and sea life base data bases as well as UBC Sea around us project. While these sets of data exist in FAO and 'Sea Around Us' project; issues of integrity arise due to differences in species composition and the fragmentation of the data which might affect the weighting system.

(4) The ecological footprints of fisheries is also an indicator from the fish and fishery module which is used in direct proportionality to the primary production required (PPR) and is estimated on the basis of trophic level catches. A fraction of total PPR in the LME from time series data (1950-2006) and landing data is used to estimate footprints as PPR is calculated separately for each specie for the fleet of all countries operating in the LME in question. This is relevant as a strong indicator of fisheries sustainability, and when related to an observed PPR, provides another index for equally assessing impact of the countries fishing within an LME; thereby making the assessment of combined footprints of different countries possible. This is computed based on estimation of available data as explained above, however issues of reliability for a particular area might arise due to variability in species composition and issues of migratory stocks.

(5) The stock status plots-an indicator within the fish and fishery module is used to determine stock exploitation status which can also guide towards achieving sustainable yields. It is derived as a percentage of stocks of a given status and percentage of catches extracted from stocks of a given status by a given year. It is relevant in that it provides the fraction of the reported landings derived from stocks in various phases of development over series of years as opposed to ordinarily the number of such stocks. Data can be obtained in time series from the fishery database with FAO and UBC Sea around us project and University of Kiel. Initial investigation on the accessibility of this data revealed that it is computed from the data for reported landings as developed by UBC and it is strongly related to 'LME carrying capacity indicator' in addition to several others.

(6) The fishing effort is another indicator for the fish and fishery module and is used to indicate the cost of fishing itself in relation to bottom habitat modification that is occasioned by fishing gear. Its methodology is computed globally through the expression of kilowatts days globally by continents, by countries, by vessel tonnage class and by vessel or gear types. Fishing effort has been recognised as the most important stressor presently in global LMEs. Presently, global efforts are continuing in developing a comprehensive and spatially explicit database for this indicator. This

indicator may be developed before or during the full size project (FSP) of the TWAP assessment in future or may possibly be available locally by some countries around the JDZ but issues of credibility should be strongly considered if this is the case.

(7) The projected catch potential-an indicator within the fish and fishery module is expected to be used to illustrate impacts of natural variability on ecosystem state and services thereby helping to prioritize climate change adaptation strategies. It is computed by projecting future changes in maximum catch potential by 2055 under two climate change scenarios based on the analysis of 1066 species of commercially exploited marine fish and vertebrates. Its relevance is in its ability to project change or variation in maximum catch potential which could directly affect global food security and the relevant MDG and consequently lead to food and revenue losses for tropical countries. Although yet to be tested for LMEs; it is believed that it could be structured to suite conditions for the global LMEs. Data on this indicator is however incorporated within the TWAP-LME methodology, but it is yet to be tested anywhere else.

(8) The LME carrying capacity in relation to maximum sustainable yield-the last among the TWAP-LME fish and fishery module indicators is used to observe changes under different environmental conditions as the ecosystem structure and processes change. It is usually computed either by use of fish biomass estimates in LMEs using the Ecopath with Ecosim modelling approach and software or by the concept of ecosystem carrying capacity ECC as adopted by some published Strategic Action Programmes (SAPs) for some of the LMEs such as the Yellow Sea which takes into account indicators from all the 5 LME modules. It is recognised as a very important tool for the recovery and sustainability objectives for a degraded LME and the resultant information is presented as graphs, images and visuals. Initial findings on the availability of this data revealed that the software is freely available and variables from data sets are converged to construct models for each of the global LMEs. This indicator is also strongly related to all the 5 modules for its ability to paint a bigger picture of ecosystem trends.

### **The pollution and ecosystem health module indicator**

The pollution and ecosystem health module has eleven main TWAP-LME indicators; namely the mercury contamination, plastic resin pellets, nutrients, negative trend in dissolved oxygen concentration, shipping density, harmful algal blooms HABs, freshwater discharge, sediment discharge, seamounts at risk, change in protected area coverage and change in extent of mangrove habitat.

(1) The mercury contamination is used to portray the extent and significance of negative trend on human health in relation to the aquatic environment and its methodology is computed through the correlation of inorganic mercury in matrices to production and accumulation of organic mercury in the marine environment. Its relevance is due to its long range atmospheric transport and persistence in the environment once it is induced anthropogenically. Data and practice are only available for Europe, North America and Japan presently. There is no known currently reliable data on this indicator for most African LMEs.

(2) The plastic resin pellets is as a result of their ability to absorb hydrophobic compounds such as persistent organic pollutants- POPs present in surrounding sea water with a very large concentration. Current methodology relies on a global network of volunteers and agencies that

collect pellets from beaches and send them to a single laboratory in Tokyo for analysis. The concentration of pellets indicates variations in land use and industrial development in the adjoining coastal waters and catchments. Presently data exists in fragmented data sets from the laboratory in Japan. Attempts to look at the possibility of this data's existence revealed that the data exists, but fragmentally and is not easily accessible and as such currently impracticable.

(3) The nutrients indicator-is used in determining nutrient over enrichment due to its high impact on the environment and is computed through spatially-explicit global watershed model (NEWS) that relates human natural processes in watersheds where dissolved inorganic nitrogen (DIN) load per LME could be aggregated. Relevant in that LMEs over enrichment have been well documented globally as areas of nutrient loading with increase in frequency of occurrences. Although data exists for some regions in forms of maps and visuals, it is however yet to be included in any TWAP-LME assessment but is expected to be included in future.

(4) The negative trends in dissolved oxygen concentration indicator-highlights the linkages of hypoxic zones on the continental shelf to eutrophication. It is calculated as a proportion of all data series within an LME that portrays a negative trend in dissolved oxygen DO concentration based on time series data and measurements. Its relevance is because as DO depleted or hypoxic zones increase globally, they tend to have pronounced effects on marine communities and fisheries. Data exists with Scientific Committee on Ocean Research SCOR but not easily accessible.

(5) The shipping density indicator is used to determine shipping traffic which is a dominant source of distant anthropogenic sound in the ocean that impacts on marine life within the marine ecosystem. Its methodology currently is via the estimation of ship-sourced inputs of some contaminants such as tributyltin TBT and hydrocarbons as a function of ship traffic and is relevant as a result of being a significant source of categories of pollutants mentioned earlier and perhaps of some invasive species through ballast water discharges. Ship traffic data could be obtained for various time scales from the NOAA through its Voluntary Observing Ship VOS programme, GESAMP and IMO. This indicator may also be further developed by considering how invasive species are introduced through Ballast Water discharges from ships; as such collaboration with the IMO for the indicator development should be considered so as to make it all encompassing to truly measure shipping density and obtaining geographically referenced data capable of easily identifying flag state.

(6) Harmful algal blooms (HABs) is an indicator for the pollution and ecosystem health module due to the threats it poses to ecosystem status as HABs have been found to cause massive fish kills, contamination of seafood with toxins and alteration of ecosystem health and services and in the process endangering health and livelihoods of dependents of this important ecosystem services. Methodology for computing this indicator is in the compilation of the HABs data by the IOC-UNESCO and other regional initiatives such as the NOAA Harmful Algal Blooms Observing System (HABSOS) that hold data for the Gulf of Mexico and the GEF LME projects. This is in addition to a review of cataloguing systems susceptible to symptoms of eutrophication which provided a global map of hypoxia events. This indicator possesses strong links with fishery but the current fragmentation of the data set may bring up issues of integrity in addition to potential computational disparities.

(7) Freshwater discharge as an indicator is used to examine how human activity and climate change variability alter freshwater input to coastal and marine habitat and it is relevant since habitat alteration has serious consequences for the provisioning function of ecosystems as well as for the

communities that depend on them. It uses the Global NEWS model for its methodology in similarity with the nutrient indicator methodology-which in itself is yet to be fully developed-although fragmented data exists for some of the GEF LME projects. When fully developed and the fragmented data aggregated, this indicator might be very useful for monitoring the health of the marine ecosystem.

(8) Sediment discharge indicator is to determine the extent of sediment smothering on critical habitats such as sea grasses and coral reefs. This is particularly important since human interference such as dam construction and water diversions significantly alter sediment load to coastal waters thereby affecting ecosystems and their services. Its methodology and data availability status is similar to the nutrient and freshwater discharge indicators as outline above.

(9) 'Seamounts at risk indicator' is used to examine key areas for biodiversity in the ocean and supports a range of vulnerable habitats. It is computed by recording species in hydrothermal vents and cold seep locations in hydrothermally active and non-active seamounts. They are relevant for determining the threats posed by these conditions and destructive fishing practices such as bottom trawling. Freely available global data layer exists which was compiled from multiple sources on Seamounts Online website. The availability of this data proved difficult as the freely available online data appeared incomprehensive and fragmented.

(10) Change in protected area coverage-as an indicator is important in sustaining ecosystem health. Methodology is based on a global scale layer of data compiled by UNEP-WCMC from multiple data sources and the indicator itself is derived from the World Database on Protected Areas WDPA which is recognised as the most up to date globally spatial data sets on marine and terrestrial protected areas and data are fed into the WDPA from national governments or approved NGOs in varying formats and subsequently processed into standard GIS formats and made available online. The issue with this indicator is in their integrity since they are from a variety of sources that may not be independently verified and are not straight forward as the methodologies from the contributors are not clearly defined and straight forward.

(11) 'Change in extent of mangrove habitat' is an indicator used to examine mangrove cover which has been recognised as key to success of biodiversity targets since mangroves are under threat from anthropogenic climate change. It has a similar methodology to the 'Change in protected area coverage' indicator and is extremely valuable in terms of maintaining ecosystem services. A global data layer exists but for very limited locations.

### **The socioeconomic module indicator**

The socio economic module is based on some policy assumptions which are (1) increase in capital within sustainable levels in terms of social capital, human capital, natural capital, physical capital and financial capital as indices (2) reduction in vulnerability to natural disasters, to disease and to economic fluctuation as indices (3) enhancement of wellbeing through universal education, gender equality, reduction of child mortality and improvements in maternal health as indices.

For benefits derivable from ecosystem perspective; they have been streamlined for TWAP purposes into four measurable indicators, namely GDP fisheries, human development index HDI, deaths per 100000 caused by climate change related disasters and marginal economic value (MEV).

(1) GDP fisheries as an indicator is useful for indicating the value achievable from fisheries per given nation and per two nations in a shared system and is computed as the value of fishery output-nominally- in a given year per nation or two nations in a shared system while real GDP measures same in two or more years. This is relevant for measuring dependence or reliance on fisheries provisioning services among the ecosystem services. Data is available with FAO FishStat per any given nation. Investigation on this data revealed that although it is not freely available but is obtainable on request from FAO.

(2) Human development index is used for identifying level of livelihood derived from fishery ecosystem provisioning services and is computed as composite of life expectancy at birth, adult literacy rate and per capita GDP. This could also be relevant as a good example of an index comprising of three indicators and data is available for any given nation with World Development Indicators WDI and FAO. Data on this indicator is freely available and easily accessible.

(3) 'Deaths per 100000 caused by climate related disasters'-indicates how natural disasters affect humans and is assumed to be based on natural occurrences. Relevant for examining climate change impacts on humans and ecosystems. Data is available nationally from censuses, FAO, WDI and climate risk index per any given nation. Data on this indicator may also be collected nationally from individual nations' population agencies.

(4) Marginal Economic Value (MEV) is an indicator that identifies services/impacts on the ecosystem services such as destruction of habitats. Its methodology is computed as the additional value gained or lost by a change in provision of flow or in a level of stock. This is recognised as also being more relevant to policy making because decisions involve incremental changes in ecosystem provisioning services. A demonstration project is currently being developed through the Southeast Pacific Action Plan under the UNEP Regional Seas Programme, McGill University, UN Economic Commission for Latin America and the Caribbean and the Andean Development Bank. Currently data exists for some developed nations and in the process of being developed globally.

## TWAP-LME Indicators along with ideal indicator requirements

TWAP-LME INDICATORS	DATA AVAILABILITY	PRACTICALITY	COST-EFFECTIVENESS	COMPREHENSIVENESS	ACCEPTABILITY	ROBUSTNESS
Primary Productivity						
Sea Surface Temperature						
Oceanographic Fronts						
Reported Landings						
Value of Reported Landings						
MTI & FIB						
Ecological Footprints of Fisheries						
Stock Status Plots						
Fishing Efforts						
Projected Catch Potential						
LME carrying capacity in relation to MSY						
Mercury Contamination						
Plastic Resin Pellets						
Nutrients Indicator						
Negative Trends in Dissolved Oxygen Concentration						
Shipping Density						
Harmful Algal Blooms (HABs)						
Freshwater Discharge						
Sediment Discharge						
Seamounts at Risk						
Change in Protected Area Coverage						
Change in extent of Mangrove Habitat						
GDP Fisheries						
Human Development Index (HDI)						
Deaths/100000 caused by climatic Disasters						
Marginal Economic Value (MEV)						

## TWAP-LME Indicators along with Indicator selection criteria

TWAP-LME INDICATORS	Chosen Indicator	Assigned Weight	Score Given
Primary Productivity			
Sea Surface Temperature			
Oceanographic Fronts			
Reported Landings			
Value of Reported Landings			
MTI & FIB			
Ecological Footprints of Fisheries			
Stock Status Plots			
Fishing Efforts			
Projected Catch Potential			
LME carrying capacity in relation to MSY			
Mercury Contamination			
Plastic Resin Pellets			
Nutrients Indicator			
Negative Trends in Dissolved Oxygen Concentration			
Shipping Density			
Harmful Algal Blooms (HABs)			
Freshwater Discharge			
Sediment Discharge			
Seamounts at Risk			
Change in Protected Area Coverage			
Change in extent of Mangrove Habitat			
GDP Fisheries			
Human Development Index (HDI)			
Deaths/100000 caused by climatic Disasters			
Marginal Economic Value (MEV)			

# Appendix Seven

**The returned feedback and comments document**



**NIGERIA-SAO TOME & PRINCIPE  
JOINT DEVELOPMENT AUTHORITY**  
*NON-HYDROCARBON RESOURCES DEPARTMENT*

REF: 5/NHR/JDA/001

DATE: 26<sup>th</sup> January, 2015

Aliyu Hamza Dan'Agalan  
Department of Geography  
University of Portsmouth  
Buckingham Building  
Lion Terrace  
Portsmouth PO1 3HE  
United Kingdom

Dear Sir,

**RE: REQUEST FOR FEEDBACK AND COMMENTS BASED ON RESEARCH  
OUTCOMES**

Your letter dated 9<sup>th</sup> December, 2014 referred.

2. Further to your earlier interactions with JDA regarding your PhD research titled "*The use of selected indicators to examine marine fishery sustainability within the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ)*" and your request for feedback and comments based on research outcomes, we hereby forward our input in Tables 1 & 2 of the Transboundary Waters Assessment Programme – Large Marine Ecosystem (TWAP-LME) Indicators along with ideal indicator requirements.

3. Furthermore the justifications for our responses are as follows:

**i. Conduct of Marine Surveys of the JDZ:-**

JDA in the collaboration with the Royal Norwegian Government had successfully concluded both wet and dry season Marine Environmental Surveys of bottom fauna, selected physical and chemical compounds and fisheries survey in the Joint Development Zone between Nigeria and Sao Tome & Principe in 2011 and 2012 respectively, thus JDA is currently managing non-hydrocarbon resources in the JDZ from an environmental stand point.

Therefore, the (TWAP-LME) indicators being currently applied by JDA with a view to developing a robust and sustainable fisheries sub-sector in the JDZ are environmental and they are listed as follows;

- a. Primary Productivity
- b. Sea Surface Temperature
- c. Oceanographic Fronts
- d. Mercury Contamination
- e. Plastic Resin Pellets
- f. Nutrients Indicator
- g. Negative Trends in Dissolved Oxygen Concentration
- h. Shipping Density
- i. Harmful algal Blooms (HABs)
- j. Sediment Discharge
- k. Seamounts at Risk
- l. Marginal Economic Value

**ii. Non-Commencement of Commercial Fisheries and Fisheries related activities in JDZ:-**

The non-commencement of commercial fishing and fisheries related activities in the JDZ is responsible for JDA current non-application of bio-economic and economic TWAP-LME Indicators. These indicators are listed as follows;

- a. Reported Landings
- b. Value of Reported Landings
- c. MTI & FIB
- d. Ecological Footprints of Fisheries
- e. Stock Status Plots
- f. Fishing Efforts
- g. Projected Catch Potential
- h. LME Carrying Capacity in relation to MSY
- i. GDP Fisheries

**iii. Location of the JDZ:-**

JDZ is located in the eastern region Gulf of Guinea extending approximately between the latitude 1°3' and 3° North, for this reason certain TWAP-LME indicators are not applicable. These indicators are as follows:

- a. Change in Protected Area
- b. Change in extent of Mangroove Habitat
- c. Human Development Index (HDI)
- d. Deaths/100000 caused by Climatic Disaster

**vi. Scoring:-**

The overall scoring of the indicators is based solely on JDA's current environmental data and strategy, non-commencement of fishing and fisheries related activities and location of the JDZ.

4. While looking forward to receiving a copy of your thesis, we wish to use this opportunity to congratulate you in advance.



**EUGENIO NASCIMENTO**  
Executive Director  
Non-Hydrocarbon Resources



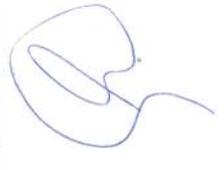
**COLLINS KALABARE**  
Executive Director  
Monitoring & Inspection

## TWAP-LME Indicators along with ideal indicator requirements

TWAP-LME INDICATORS	DATA AVAILABILITY	PRACTICALITY	COST-EFFECTIVENESS	COMPREHENSIVENESS	ACCEPTABILITY	ROBUSTNESS
Primary Productivity	✓	✓	✓	✓	✓	✓
Sea Surface Temperature	✓	✗	✓	✓	✓	✓
Oceanographic Fronts	✓	✓	✓	✓	✓	✓
Reported Landings	✗	✗	✗	✗	✗	✗
Value of Reported Landings	✗	✗	✗	✗	✗	✗
MTI & FIB	✗	✗	✗	✗	✗	✗
Ecological Footprints of Fisheries	✗	✗	✗	✗	✗	✗
Stock Status Plots	✗	✗	✗	✗	✗	✗
Fishing Efforts	✗	✗	✗	✗	✗	✗
Projected Catch Potential	✗	✗	✗	✗	✗	✗
LME carrying capacity in relation to MSY	✗	✗	✗	✗	✗	✗
Mercury Contamination	✓	✓	✓	✓	✓	✓
Plastic Resin Pellets	✓	✓	✓	✓	✓	✓
Nutrients Indicator	✓	✓	✓	✓	✓	✓
Negative Trends in Dissolved Oxygen Concentration	✓	✓	✓	✓	✓	✓
Shipping Density	✓	✓	✓	✓	✓	✓
Harmful Algal Blooms (HABs)	✓	✓	✓	✓	✓	✓
Freshwater Discharge	✗	✗	✗	✗	✗	✗
Sediment Discharge	✓	✓	✓	✓	✓	✓
Seamounts at Risk	✓	✓	✓	✓	✓	✓
Change in Protected Area Coverage	✗	✗	✗	✗	✗	✗
Change in extent of Mangrove Habitat	✗	✗	✗	✗	✗	✗
GDP Fisheries	✗	✗	✗	✗	✗	✗
Human Development Index (HDI)	✗	✗	✗	✗	✗	✗
Deaths/100000 caused by climatic Disasters	✗	✗	✗	✗	✗	✗
Marine Economic Value (MEV)	✓	✓	✓	✓	✓	✓

## TWAP-LME Indicators along with Indicator selection criteria

TWAP-LME INDICATORS	Chosen Indicator	Assigned Weight	Score Given
Primary Productivity	✓	HIGH	4
Sea Surface Temperature	✓	HIGH	4
Oceanographic Fronts	✓	HIGH	4
Reported Landings	x	x	x
Value of Reported Landings	x	x	x
MTI & FIB	x	x	x
Ecological Footprints of Fisheries	x	x	x
Stock Status Plots	x	x	x
Fishing Efforts	x	x	x
Projected Catch Potential	x	x	x
LME carrying capacity in relation to MSY	x	x	x
Mercury Contamination	✓	HIGH	4
Plastic Resin Pellets	✓	HIGH	4
Nutrients Indicator	✓	HIGH	4
Negative Trends in Dissolved Oxygen Concentration	✓	HIGH	4
Shipping Density	✓	MODERATE	3
Harmful Algal Blooms (HABs)	✓	HIGH	4
Freshwater Discharge	x	x	x
Sediment Discharge	✓	FAIR	2
Seamounts at Risk	✓	FAIR	2
Change in Protected Area Coverage	x	x	x
Change in extent of Mangrove Habitat	x	x	x
GDP Fisheries	x	x	x
Human Development Index (HDI)	x	x	x
Deaths/100000 caused by climatic Disasters	x	x	x
Marine Economic Value (MEV)	✓	HIGH	4

# **Appendix Eight**

**UPR 16 Form-Declaration of Ethical Conduct**

# FORM UPR16

## Research Ethics Review Checklist



Please include this completed form as an appendix to your thesis (see the Postgraduate Research Student Handbook for more information)

<b>Postgraduate Research Student (PGRS) Information</b>		<b>Student ID:</b>	474510
<b>PGRS Name:</b>	ALIYU HAMZA DAN'AGALAN		
<b>Department:</b>	GEOGRAPHY	<b>First Supervisor:</b>	Dr JONATHAN POTTS
<b>Start Date:</b> (or progression date for Prof Doc students)	OCTOBER, 2011		
<b>Study Mode and Route:</b>	Part-time <input type="checkbox"/>	MPhil <input type="checkbox"/>	MD <input type="checkbox"/>
	Full-time <input checked="" type="checkbox"/>	PhD <input checked="" type="checkbox"/>	Professional Doctorate <input type="checkbox"/>

<b>Title of Thesis:</b>	THE USE OF SELECTED INDICATORS TO EXAMINE MARINE FISHERY SUSTAINABILITY WITHIN THE NIGERIA-SAO TOME & PRINCIPE JOINT DEVELOPMENT ZONE
<b>Thesis Word Count:</b> (excluding ancillary data)	83,083

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University's Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

### UKRIO Finished Research Checklist:

(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: <http://www.ukrio.org/what-we-do/code-of-practice-for-research/>)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
b) Have all contributions to knowledge been acknowledged?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
e) Does your research comply with all legal, ethical, and contractual requirements?	YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>

### Candidate Statement:

I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)

<b>Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):</b>	SFEC 2013 027/130813
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If you have *not* submitted your work for ethical review, and/or you have answered 'No' to one or more of questions a) to e), please explain below why this is so:

**Signed (PGRS):**

A handwritten signature in blue ink, appearing to read "J. G. ...".

**Date:** 18/09/2015