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**CLIMATE CHANGE MITIGATION VIA MODULAR
REFINERY IN THE CONTEXT OF ILLEGAL OIL
REFINING IN THE NIGER DELTA REGION.**

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Declaration

I, Ejike Innocent Okonkwo, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

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Dedication

To the Most-High God, and people working to mitigate climate change.

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List of Abbreviations and Acronyms

AP	Amnesty Programme
ATC	Authority to Construct
AGO	Automotive Gas Oil
ATK	Aviation Turbine Kerosene
BPD	Barrels Per Day
CSG	Civil Society Groups
CCC	Climate Change Convention
CREDC	Community Research and Development Centre
CITA	Companies Income Tax Act
CAC	Corporate Affairs Commission
CRS	Corporate Social Responsibility
NDDC	Delta Development Commission
DPR	Department of Petroleum Resources
DPK	Dual Purpose Kerosene
EIA	Environmental Impact Assessment
FMEN	Federal Ministry of Environment of Nigeria
ERA	Environmental Rights Action
GHGs	Greenhouse Gases
GDP	Gross Domestic Product
HSE	Health, Safety and Environmental
IPCC	Intergovernmental Panel on Climate Change
JTF	Joint Task Force
KP	Kyoto Protocols
LTE	License to Establish
LTO	License to Operate
MW	Megawatts
MDGs	Millennium Development Goals
MNDA	Ministry of Niger Delta Affairs

MPR	Ministry of Petroleum Resources
MOCs	Multinational Oil Companies
NBS	National Bureau of Statistics
NEPA	National Electric Power Authority
NIWA	National Inland Waterways
NCTL	Nembe Creek Trunk Line
NGOs	Non-Governmental Organizations
NEITI	Nigerian Extractive Industries Transparency Initiative
NNPC	Nigerian National Petroleum Corporation
NN	Nigerian Navy
NSCDC	Nigeria Security and Civil Defense Corps
NDDC	Niger Delta Development Commission
NDY	Niger Delta Youths
OPEC	Organization of Petroleum Exporting Countries
PPMC	Pipeline Products Marketing Company
PHCN	Power Holding Company of Nigeria
PMS	Premium Motor Spirit
PPP	Public Private Partnership
RF	Radioactive Forcing
SCF	Saving for Clean Future
SCF	Standard Cubic Feet
SDGs	Sustainable Development Goals
SDN	Stakeholder Democracy Network
SPDC	Shell Petroleum Development Company
SLCP	Short-Lived Climate Pollutants
TNP	Trans Niger pipeline
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
UNN	University of Nigeria Nsukka
WAGP	West African Gas Pipeline

Abstract

This study examines the perception of the local community in the Niger Delta region on the socio-economic and environmental costs and benefits of climate change mitigation via modular refinery. According to IPCC (2014, p.6) “mitigation outcome may be influenced by how individuals perceive risks and uncertainties and take them into account.” The ancillary costs and benefits theory of climate change mitigation serves as a guide in the study. The theory shows that mitigation has ancillary effects (costs and benefits), and the parties involved are more likely to participate in mitigation if they perceive the benefits to outweigh the costs (Krupnick, Burtraw, & Markandya, 2000). Hence, the perception of the local community shapes their involvement in the mitigation process which is vital for achieving mitigation objectives. The literature review provides the contextual background; it establishes the link between oil production, environmental degradation, weak institution, loss of livelihood and the consequent emergence of illegal oil refinery as a survival alternative in the region. The latter constitutes one of the drivers of climate change in the region because they produce more criteria pollutants and are not subjected to environmental impact assessment (Iheriohanma 2016, p.30).

This study is based on qualitative research methods because it deals with subjective social realities. Data was generated using semi-structured interview to gain in-depth insight on respondents’ perception. The findings of this study show that most members of the local community are optimistic on the outcome of mitigation i.e. they perceive ancillary mitigation benefits to outweigh the costs. Therefore, the study concludes that future mitigation outcome has high chances of success in the region given the prevailing socio-economic circumstances. The study serves as a guide for policy makers and international environmental institutions on the likely future mitigation outcome in the region. It recommends among other things, the establishment of a mandatory *Saving for Clean Future* (SCF) contributory funds for staff of modular refineries, to ensure gradual transitioning to cleaner forms of energy.

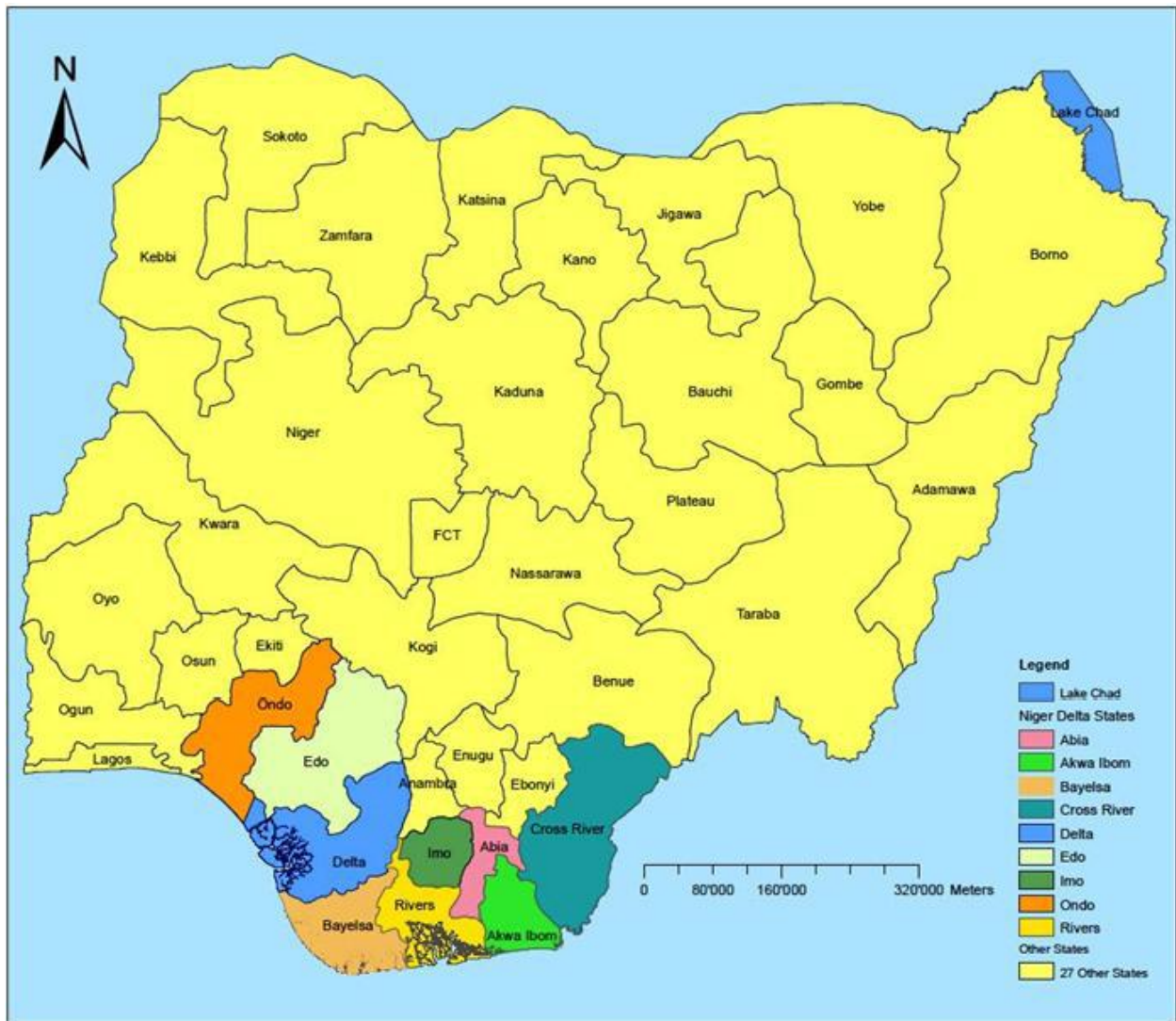


Figure1: Map Showing the Niger Delta region (Ite et al., 2013).

CHAPTER ONE: INTRODUCTION

1.0.Introduction

This Chapter introduces the concept of climate change mitigation. Furthermore, it highlights the driver of climate change in the region (illegal refining) and provides the reason and importance of mitigation. It also presents the study objectives and research questions.

Climate change is one of the global environmental issues that require more attention because it affects the world's resource availability. For instance, climate change leads to diminishing essential resources such as agricultural lands and yields (Oladipo, 2008; Anyadike, 2009). It also contributes to resource conflict, forced migration occasioned by flood and drought (Ozor, 2009). Burning of fossil fuel from illegal refining forms one of the leading causes of global warming and climate change (Shafiee & Topal, 2009; Anyadike, 2009). Many economies still rely on fossil fuel, especially the oil producing countries, due to the huge financial returns. Despite these financial gains, oil production contributes to environmental issues (Goldemberg, 2006). To reduce these impacts of climate change therefore, requires an effort to reduce the driving causes. Iheriohanma (2016, p.46) notes that climate change mitigation refers to “any process, activity or action designed to avoid, ameliorate or remedy significant adverse environmental impacts.” Put differently, it refers to “efforts to cut or prevent the emission of greenhouse gases limiting the size of future warming. It may encompass attempts to remove greenhouse gases from the atmosphere” (British Broadcasting Corporation News 2014, p.1). Mitigating climate change in the Niger Delta via modular refinery aligns with the UNFCCC stipulation which supports that “actions to address climate change should be justified economically based on the context and should also contribute in solving other environmental problems” (UNFCCC 1992, p.2).

Studies on climate change mitigation via modular refinery in the Niger Delta are still at nascent stage. For instance, earlier studies on mitigation in the region such as (Olujimi, 2007; Etuonovbe, 2008; Etuonovbe, 2008) focused mostly on impacts and adaptation. Hence, there is a need to unravel other aspects of addressing climate change. In a bid to fill the research gap, this study therefore examines the perception of the local community on the ancillary cost and benefits of climate change mitigation via modular refinery. The outcome of the research is important for planning future mitigation in the region.

1.1. Problem Statement and Rationale

One of the major drivers of climate change in the Niger Delta region is the operation of illegal refinery. Iheriohanma (2016, p.30) maintained that “major environmental devastation from oil refining in the Niger Delta region is caused by operation of illegal refineries”. Illegal oil refinery operates without an Environmental Impact Assessment (EIA), hence the absence of supervision or monitoring of their operations “their pollution may have more *Criteria Pollutants*¹ than a normal refinery” (ibid). Fossil fuel combustion is one of the highest emitter of carbon “delaying mitigation efforts beyond those in place today through 2030 is estimated to increase the difficulty of transitioning to low longer-term emission levels” (IPCC, 2014, p.12). Nigeria has over 123 illegal oil refineries in the Niger Delta making the country one of the highest emitters of greenhouse gases (Akinro, Opeyemi, & Ologunagba, 2008). Unabated heating of the atmosphere could lead to increased temperature rise by the end of this century (Sims, Goresvski, and Anenberg 2015, p.4).

The activities that drive climate change such as illegal oil refining still persist in the Niger Delta. The prevailing socio-economic condition in the region influences the lifestyle choices of the local communities. Unemployed youths engage in illegal oil activities which pollute the environment and have negative impact on the climate. This situation is compounded because non-mitigation priorities still dominates the agenda of policy makers in most developing countries as observed by (Sims, Goresvski, & Anenberg, 2015). Furthermore, lack of modern technology, weak political institutions to formulate and implement climate change mitigation policies abound. IPCC (2014, p.20) notes that “emission from energy sector are projected to almost double or even triple by 2050.” Therefore, “reducing toxic gases can help slow the rate of climate change, reduce local air pollution, improve human health, ensure food and water securities, and support the Sustainable Development Goals” (Sims, Goresvski, and Anenberg 2015, p.14). Thus, climate change mitigation is a collective effort without which effective mitigation cannot be achieved (IPCC, 2014). All individuals, communities and countries must collaborate in addressing climate challenges.

¹ Emission of industrial gases above the permissible national quantities (Iheriohanma, 2016).

Pollutants from illegal refining affects people close and far from the emission sources because it travels long distance (Shindell, et. al.2008). However, the people closest to the sources of emission feel most of the effects as shown by (Sims, Goresvski, & Anenberg, 2015). Hence, the Niger Delta region is most affected by the impacts of climate change from illegal oil activities. O’connor (2000, p.2) claims that “many parts of the developing economies experience high incidence of respiratory diseases which is among the leading causes of mortality and mobility, and air pollution is among the aggravating factors in many cases”. This research was primarily motivated by the 2016 outbreak of black carbon that engulfed the city of Port Harcourt in the Niger Delta. Many reports suggest that these emissions emanated from the activities of illegal oil refining, these activities contribute to climate change in the region. Based on the above, it became imperative to investigate the perception of local community on mitigation of climate change via a medium that would also curb the activities of illegal refining.

Modular refinery serves as a mitigation pathway because it is an intersecting medium that would address the socio-economic situation that drives climate change in the region as well as reduce the emission of pollutants. The outcome of the study would serve as an indication and guide to policy makers on the possible future mitigation outcome in the region, based on these perceptions. The research would also facilitate the planning and implementation of mitigation policies and programs by the government, MOCs and other international environmental organizations. Deductive content analysis was used in interpreting the findings because the research was guided by the application of general mitigation theory to a specific context. Hsieh & Shannon (2005, p.1) notes that content analyses are used when theory forms the basis for analysis and interpretation. Given that mitigation outcome would depend mostly on the perception and participation of the local community in the mitigation process, two research questions were thus used in the study to find out these perceptions;

- *How does the local community in Port Harcourt perceive modular refinery as a tool for mitigating climate change?*
- *What are the possible ancillary socio-economic costs and benefits of climate change mitigation via modular refinery?*

1.2. Structure of thesis.

This study is structured into seven various parts **Chapter one** has the introduction, problem statements, research questions, and research objectives. **Chapter two** captures the contextual background of the Niger Delta region which is the study area. It also highlights the Nigeria oil sector and its impacts in the region i.e. environmental degradation, loss of livelihood and the emergence of illegal oil refining which is a driver of climate change in the region. **Chapter three** presents the Methodology, the research design, and data type adopted. **Chapter Four** is focused on the theoretical framework. **Chapter Five** presents climate change mitigation in the Niger Delta starting with the background of mitigation which is the UNFCCC and IPCC, and then an overview of modular refinery which is the mitigation pathway. **Chapter Six** present findings and discussions from the research questions. **Chapter Seven** contains the conclusion, recommendation, references, and appendixes.

CHAPTER TWO: CONTEXTUAL BACKGROUND

2.0. Introduction

This chapter gives an overview of the contextual background of the study area. It explores how the socio-economic situation in the area which is mostly agriculture based, is shaped by oil production activities. Specifically, it establishes the link between oil production, environmental degradation, loss of livelihood and the consequent emergence of illegal refinery, and how the latter contributes to climate change in the region.

2.1. The Niger Delta

The Niger Delta is in South- South Nigeria. The region covers a square mile of 70,000 km (Badmus, 2010). It consists of 9 states; Abia, Akwa -Ibom, Bayelsa, Cross- River, Delta, Edo, Imo, Ondo and Rivers (Egbule, et al., 2001). The population in the region is estimated to be over 30 million people (National Population Commission, 2006). The conceptualization of Niger Delta has been highly debatable over the years with different scholars preferring various definitions of areas, some refer to the Niger Delta as; Oil producing area, South-South Geopolitical Zone, Political Niger Delta, Oil Producing Area etc. (Akpabio, & Akpan, 2010; Nwachukwu, 2008). The region has also been categorized into two; The Core Niger Delta and the Peripheral, the formal includes; Bayelsa, Delta, and River state (Okoli, 2013), and the latter includes; Abia, Akwa-Ibom, Cross River, Edo, Imo, and Ondo states (Boris, 2015). Most of the oil production however comes from just three states; Rivers, Delta and Bayelsa (Obi, & Rustad, 2011). There are about 250 dialects with Ikwerre, Ogoni, Ijaw, Ogba, Ahoada, Urhobo, Ekwere, Kalabari, Ukwuani, Isoko, Oron, Anna, Ibibio, Efik, Itsekiri as the major ethnic groups (Boris, 2015). Fishing and farming are the predominant occupation in the region.

The ecosystem in the Niger Delta is endowed with rich biodiversity, distinct species of plants and animals. For instance, it has enormous flora, fauna, and variety of soil type (Osuji, & Adesiyun, 2005; Ugochukwu, & Ertel, 2008). The wetland stands as number one in Africa, in addition, it boasts of both lowland and mangrove swamp forest respectively (Singh, Moffat, & Linden, 1995; Eweje, 2006). The region has abundant of natural resources such as oil, gas bitumen, wildlife, and timber (Asakitikpi, & Oyelaran, 2000). The region generates 95% of Nigeria revenue (Brisibe, 2001).

However, since the discovery and exploration of oil, the economy of the region has become dependent on oil (Nzeadibe, & Ajaero, 2010). The climate is adversely affected, and the environment subjected to degradation due to the activities of the Multinational Oil Companies (MOCs) and illegal oil operations. There is high rate of environmental pollution from reoccurring oil spills, gas flaring, carbon emission by heavy vehicles, thus resulting to increasing temperature, abnormal changes in the pattern of rainfall, flooding, soil erosion, loss of soil quality and decreased agricultural outputs (Etim, Ituen, & Folarin, 2008). Paucity of basic infrastructure such as health facilities, safe drinking water, and stable power supply characterizes the region. Ojo (2010) notes that these negative externalities of refining activities affect the economy of the local people hence, predisposing them to engage in resource agitation expressed through militancy, vandalism, and oil theft (Tonwe, & Aghedo, 2013).

2.2. The Oil Sector in Nigeria

The turning point in the Nigerian economy began in 1956 which marked the period of crude oil discovery by Shell in Oloibiri located in the Niger Delta (Odularu, 2008). Since then, oil has been discovered in many parts of the country both on and off shore (Njoku, 2016). There is still huge local demand of oil exceeding supply in Nigeria (Okoromadu, 2016). Nigeria has four refineries in; Port-Harcourt, Warri, and Kaduna. These refineries were commissioned in 1965, 1978, 1980 and, 1989 with 35,000bpd, 100,000bpd, 100,000bpd and, 150,000 bpd respectively (Odularu 2008, p.9). However, these refineries still work below installed capacity (SDN, 2013). In 1970, Nigeria joined the Organization of Petroleum Exporting Countries (OPEC), it also set up the Nigeria National Petroleum Corporation (NNPC) in 1977. The NNPC is a Nigerian government owned and controlled company.

2.2.1. Multinational Oil Companies (MOCs)

Many multinational oil companies (MOCs) are involved in the business of oil exploration in the region. The major multinational oil companies (MOCs) in Nigeria includes; Shell (50%), Nigeria National Petroleum Corporation (NNPC) has 55% interest. Exxon Mobil, Chevron, Texaco, Eni, Agip and Total accounts for the remaining 50%, with 60% stake by the Nigerian government. (Odularu, 2008)

2.2.2. Structure and Products

Nigeria has hundreds of oil blocks, and billions of oil reserves, with more than half of the country's oil reserves located in the onshore and offshore of the Niger Delta. It has "5,120 kilometers of products and crude pipelines, 21 storage depots, and one petroleum import terminal at Atlas Cove, Lagos" (Njoku 2016, p.49). The surveillance of pipeline by the JTF from vandals is difficult due to the terrain composed of numerous creeks. The upstream sector, downstream and gas form the three sub-sectors of the Nigerian oil sector. However, the downstream sector responsible for the distribution of petroleum products to final consumers, face the most challenges that have led to regular shortage of products in the country. The sub sector was deregulated in 2003 in a bid to tackle this issue (Odularu, 2008). Nigeria has one of the best quality crude content in the world. It produces "Antan Bonny Light, Bonny Medium, Brass Blend, Escravos Light, Forcados Blend, IMA, Odudu Blend, Pennington Light, Qua-Iboe Light and Ukpokiti" (Iheriohanma, 2016 p.13). Products consumed in Nigeria include; Premium Motor Spirit (PMS), Automotive Gas Oil (AGO), Dual Purpose Kerosene (DPK), Aviation Turbine Kerosene (ATK) (Adeosun, & Oluleye, 2016).

2.2.3. Challenges confronting the Oil Sector

2.2.3.1. Bureaucracy

Challenges confronting the oil sector include but not limited to; inefficiency in its operations due to high dependence on the Ministry of Petroleum Resources (MPR) for major decision. This lack of autonomy and the bureaucratic nature of the ministry hamper the operations of the NNPC. The oil sector has three major regulators; The Ministry of Petroleum Resources (MPR), Nigeria National Petroleum Corporation (NNPC), and the Department of Petroleum Resources (DPR). The operations of these bodies are highly bureaucratic thus affecting growth and investors' confidence. USD 15 Billion is lost annually in regulatory uncertainties as noted by the Nigerian Extractive Industries Transparency Initiative (NEITI) (Adeosun, & Oluleye 2016, p.10). (ibid) noted that "setting up institutions that will handle the coordination, regulation and marketing of all commercial activities and products of the downstream sector will help drive efficiency and healthy competition within the sector"

2.2.3.2. Infrastructure Deficiency and Limited Access to Production Materials

The oil industry is suffering from massive infrastructure deficiency due to damage to pipelines. Fuel distribution across the country has been constrained as a result. The inland waterway is too shallow for safe transportation of refined products via oil tankers. Furthermore, the absence of a rail system as an alternative distribution route, compounds the issue. Through Public Private Partnership (PPP), the infrastructure gap could be bridged. According to Adeosun, & Oluleye (2016, p.10) the completion of the planned USD 2 Billion rail concession projects by the National Inland Waterways (NIWA) would be a great boost to the much-needed infrastructure in the oil sector. Inadequate supply of feedstock due to lack of information as well as the distance of refineries from feedstock and the types of available feedstock also poses challenge to the industry. (ibid, p.13) notes that “the economic viability of a refinery is dependent on the interaction of 3 elements; the type of crude oil used, the complexity of the refining equipment and the desired type and quality of products produced.”

2.2.3.3. Insecurity of Oil Facilities and Products.

The Nigerian government is yet to successfully address illegal oil activities in the Niger Delta. Millions of dollars have been lost in the first quarter of 2016 due to vandalism of oil pipeline (Adeosun, & Oluleye 2016, p.10). Until the government succeeds in its interventions to end the agitations in the Niger Delta, bothering on environmental degradation, and unemployment, the security situation would continue. Earlier interventions such as the creation of the Ministry of Niger Delta Affairs (MNDA), and the Niger Delta Development Commission (NDDC), have not yielded the expected outcome (ibid). Militancy and communal clashes in area where oil facilities are domicile constantly leads to shut down of operations for safety of oil workers. Insecurity of products availability is also because of illegal refining, as well as hoarding of products by major oil marketers which leads to hype in domestic prices and product adulteration by black marketers etc. (Odularu, 2008).

2.2.3.4. Over dependence on Crude Oil

The Nigerian economy presently is still dependent on oil, at a time when many countries are diversifying as well as switching to alternative sources of energy, mostly renewable and clean energy. The reason for this dependency is partly because “petroleum is and would still be the major source of industrial energy over the next half-century” and oil dependent countries still receive a lot of revenue (Ogundari et al. 2016, p.3; Odell, 2004). Nigeria forms an integral part for the supply of the world’s petroleum (Cooperation, 2008). Most of the country’s foreign revenue up to 90% comes from oil production in the Niger Delta (Ekuerhare, 2002). In the 1950’s and 60’s, the agricultural sector which is now neglected, was the dominant sector in the country according to (Odularu, 2008).

2.2.3.5. Mismanagement

Nigeria failed to take advantage of the international oil boom which began in 1973 until the mid-1980. There was gross mismanagement of revenue from crude oil; hence, the Nigerian economy has retrogressed since then from being financially buoyant to a debtor nation (Odularu, 2008). Recently, Nigeria became the highest oil producing country in Africa and 11th in the world in 2013. It produced more petroleum overturning Libya’s number one position in Africa (Hunter, 2015). However, weak institutional framework and management style, affects the growth and development of the petroleum industry, it also hampers attracting new investors despite producing between 2.5 million bpd and 4 million bpd in 2004 and 2010 respectively (Odularu, 2008; Ogundari et al., 2016).

The poor management system leads to irregular turn around maintenance, and refining with outdated facilities, thus contributing to production slump (Eaton, 1997). Presently, local demand for crude products exceeds the production capacity of the four refineries in; Port-Harcourt, Warri, and Kaduna. Consequently, Nigeria still imports 80% of its petroleum products making the country the 3rd largest importer in Africa (Adeosun, & Oluleye, 2016). This problem persists even after more than four decades. The per capital refining dropped to 0.002 bpd lower in comparison to Libya and South Africa which stands at 0.06 bpd/ capital and 0.01 bpd/ capital (ibid).

2.2.3.6. Corruption and Government Negligence.

Corruption thrives in the oil sector. Njoku (2016, p.49) maintained that “some unscrupulous elements within the oil industry aid and abate pipeline vandals and oil thieves.” Efforts to address petroleum scarcity, as well as environmental degradation in the region are marred by corruption and weak institutions (Ogri, 2001). The political and business moguls sabotage efforts to build more refineries due to their selfish interest imbedded in the importation of refined crude to meet domestic demand (Odularu, 2008). Government contracts are politicized; in addition, there is unjust allocation of oil well to few elites, particularly politicians and business moguls outside the region. According to (Asu, 2016) corruption contributes to sabotaging of oil facilities and the establishment of illegal refineries by the local community as a response. The latter is aimed at ameliorating excruciating poverty and improving the living standard.

The environmental challenges have received little attention from the government and the MOCs. Government has not taken the cleanup of the Niger Delta region seriously. It is estimated that such clean up would need an average 10-15 years or more to complete (Baghebo, Ubi, & Eucharia, 2012). Delays in clean-up are usually dependent on whether the cause of spill is due to operational accidents or sabotage of oil facilities by vandals. The later results to a delayed clean up exercise. For instance, the Epubu oil spill in 1998 caused by oil sabotage took a year compared to Aleibiri spill in 1997 caused by operational accident, which took half a year to clean up (Ibaba, & Olumati, 2009). Lack of funds and technical ability are also constantly given as excuses for some of these delays (Iheriohanma, 2016). The communities therefore, feel marginalized and conspired against (Odoemene, 2011). For instance, the Ogoniland has been vastly destroyed; it is very difficult if not impossible to engage in farming activities (Idowu, 1999). The late human rights activist Ken Sarowiwa once referred to oil production in the region as an ecological war without an apparent bloodshed, however, the inhabitants still die (Iheriohanma, 2016).

Negligence and complacency has resulted to lack of health clinics, rural electrification, boreholes, and safe drinking water. Some of the few projects that were established in the region such as the amnesty program, worked well for some years before its collapse due to lack of continues funding. Okoji (2002) referred to the inequality in the distribution of proceeds in the form of revenue or provisions of basic social amenities and the negligence of environmental

cleanup as environmental and generational injustice. There are 70% poor in the region, with lack of basic amenities which means poverty amid plenty (Balouga, 2009). Many indulge in illegal refining due to the monetary rewards inherent especially when negotiation and amnesty with the government fails.

2.3. Effect on the economy

While oil discovery in Nigeria serves as a giant step towards economic development, it also serves as bedrock for ethnic and political tension in the country. Thus, culminating to the Nigerian civil war from 1967-1970 largely because of the failure to resolve issues on resource allocation. The generation of previously unimaginable revenue from oil also paved the way for successive Nigerian governments to engage in deficit, unnecessary and frivolous spending (Odularu, 2008). Refining is inevitable because crude oil only becomes useful when it has been refined (O'Rourke, & Connolly, 2003). Hydrocarbons are the major part of crude oil (Kisic et al. 2009). Hence, a major source of environmental pollution which till date is still one of the greatest issues in the Niger Delta region. The Port-Harcourt refinery for instance produces 60,000bpd as well as the associated pollution appearing from the refining process with adverse environmental effects (Otti, & Okafor, 2012).

It is paramount to mention that the discovery of oil also has some positive impacts albeit very little. It has contributed to creation of employment in various phases of oil production, transportation etc. It has also significantly contributed to the gross domestic product and has financed some government recurrent and capital expenditures (Odularu, 2008). It has boosted the country's foreign exchange reserves and have also aided in the generation of electricity. The National Electric Power Authority (NEPA) now the Power Holding Company of Nigeria (PHCN) relies on natural gas for thermal electricity generation.

2.4. Environmental impact of Oil production in the Niger Delta

2.4.1. Oil Spills

Oil spills affect most communities in the Niger Delta region. Oil spills is unavoidable even when best practiced are adopted (Aghalino, & Eyinla, 2009). It has become a great burden to oil producing countries globally (Kadafa, 2012). Excessive carbon dioxide is emitted during oil

spill in the atmosphere, resulting to high atmospheric temperature (Rao, 2002). Findings from the environmental assessment of oil theft and illegal refining by the United Nations Environmental Program (UNEP), shows that vegetation is destroyed by pollution, and surface water destroyed by oil spills (Stakeholder Democracy Network, 2013). For instance, vegetations that intercept solar radiation, regulate soil temperature, as well as reduce the impact of rainfall on the soil are damaged. Half of Shells global oil spill from its operations from 1982-1992 was in Nigeria (Ikporukpo, 2004). Poor regulation and monitoring of waste disposal activities by MOCs is one of the major drivers of spills in the region (Otokunefor, & Obiukwu, 2005).

Some of the notable incidences of oil spills include; oil tanker accidents, for instance, Escravos and Royal Dutch Shells Forcados tank accident. Both mishaps happened in 1978 and released more than 800,000 barrels into the waters (Nwilo, & Badejo, 2006). Other recorded spills include; Texaco spill 1980 (Tolulope, 2004), the Bonga oil spill 2011, the Mobil Qua Iboe oil spill 1998 (Iheriohanma, 2016). Over 1000 people were killed in Jesse spill in Delta state in 1998 (Eregha, & Irughe, 2009).

Pollution of water means denial of means of livelihood (Aluko, 2004). Oil spills have turned the region from productive to wasteland (Odjuvwuederhie, Douglason, & Felicia, 2006). Hydrocarbons are injected in the water thus contaminating many sources of clean and safe water (Etim, Ituen, & Folarin, 2008). Also, ground and surface water, and marine environment are contaminated (Iduk, & Samson, 2015). The local community in the region also experiences shortage of safe drinking water (Akinbami, & Abiona, 2014). The availability, accessibility and quality of water reflect the standard of living of the people in any given area (Eaton, 1997; Ikporukpo, 2004). The Niger Delta does not enjoy quality water due to pollution from oil spills etc. Spills also lead to low agricultural productivity, and soil infertility. Soil quality is lost and contaminated by oil pollution from either oil spillages, gas flaring, waste discharges from crude production. Seabirds are also vulnerable to spills (Wiese, & Ryan, 2003; Osuji, Egbuson, & Ojinnaka, 2005). “Oil and gas activities affect the soil fertility and the degradation of the soil leads to reduced soil structure, aeration, water holding capacity and low crop output” (Iheriohanma, 2016. p.65). Soil toxicity poses health risk to the population and the food chains are also adversely affected. Most of the physical and chemical qualities of the soil in the Niger Delta are contaminated by petroleum hydrocarbons and heavy metals (Ijah, & Antai, 2003).

Community health is at risk whenever oil spill occurs; there are higher chances for epidemics and deaths resulting from disease outbreak (Aghalino, & Eyinla, 2009). Spill has become a reoccurring event in the region (Uyigüe, & Agho, 2007). Communities in oil producing areas are less healthy due to high exposure to adverse environmental condition, pollution, contamination, disease epidemic (Darkwah, 2010). Specifically, there are high rate of cancer, respiratory diseases, birth defects and involuntary abortions (Uchegbu, 1998; Rusconi et al. 2011; Hurtig, & Sebastián, 2005; Datubo-Brown, & Kejeh, 1989; Okoji, 2002). Developing countries have high rate of annual incidences of diseases and mortality directly related to water pollution with an estimated 4 million deaths annually (Aghalino, & Eyinla, 2009).



Photo 2: Effect of Oil Spill in the Niger Delta (TheGuardian, 2011)

2.4.2. Gas flaring

Gas flaring is one of the negative sides of crude oil production which some oil producing countries such as Nigeria has failed to properly manage (Nwaugo, Onyeagba, & Nwahcukwu, 2006). It is the source of the concentration of dangerous pollutants in the region (Ede, 1995). “Gas flaring is the wasteful emission of greenhouse gases (GHGs) that causes global warming, disequilibrium of the earth, unpredictable weather changes” (Iheriohanma, 2016, p.34). Over 250 toxins such as carbon monoxide, sulfur oxide, nitrogen dioxide, methane etc. are emitted into the environment which harms both humans, and animals etc. (John, 2011; Zabbey, 2004).

Nigeria is ranked number one for gas flaring among OPEC member countries, it flares more gas than Algeria, Canada, Saudi Arabia, and Libya combined (Ologunorisa, 2001; Uyigue, & Agho, 2007) 22 billion standard cubic feet (SCF) of gas is flared in the Niger Delta region (Nwaugo, Onyeagba, & Nwahcukwu, 2006). MOCs adopt unacceptable open-flare practices in Nigeria that are no longer practiced in developed countries. The law banning gas flaring in Nigeria has not been adhered to by these multinational (Iheriohanma, 2016).

The substances that come with crude such as water and gases need to be separated before refining or selling (Nwaugo, Onyeagba, & Nwahcukwu, 2006). However, due to the lack of infrastructure to process the gases that comes with crude, it is disposed through flaring. Gas flaring is not only destructive but is also resource waste (Elvidge et al. 2009; Ismail, & Umukoro, 2012). Flaring of gas leads to reduced soil fertility and vegetations (Emoyan, 2008). The Niger Delta environment is thus characterized by preponderance of hydrocarbon combustion from gas flaring “the atmospheric temperature increases the evaporation from the water bodies which leads to heavy rainfall in the region” (Etim, Ituen, & Folarin, 2008, p.4). Gas flaring still accounts for 75% of gas production process, thus making the Niger Delta one of the leading GHGs emission areas globally (Energy Information Administration, 2003).

2.4.3. Acid rain

Gas flaring causes acid rain; it is the mixture of rainfall and poisonous gases that forms acid rain. The soil is predisposed to tremendous negative effects, as well as plants and livestock's that feeds on these contaminated plants. Crop yields are reduced due to low fertility of the soil and nutrient depletion (Odjugo, & Osemwenkhae, 2009). Acid rain also depletes the quality and longevity of corrugated roofing sheets, thus an economic burden on the community. Biodiversity in the Niger-delta is besieged by acidification and contamination which have led to loss of distinct species of plants in the region (Ajibade, & Awomuti, 2009). Some of the trees and plants lost are highly economical in terms of their pharmaceutical values (Aghalino, & Eyinla, 2009).

2.5. Socio- economic impact of Oil exploration and exploitation in the Niger Delta

2.5.1. Loss of livelihood, Poverty, and unemployment

The major occupations in coastal areas of the region are mostly hunting, farming and fishing. All these occupations are due to; the large vegetation, forest, arable wetland, and availability of rivers respectively. However, construction and installation of oil facilities needs large hectares of land, they also encroach on agricultural land as well as contamination of these area (Ogundari, Akinwale, Adepoju, & Akarakiri, 2016; Iheriohanma, 2016). Hence, oil companies destroy and undermine the environment thus leading to the loss of livelihood of the residents. Limited access to resources needed for meaningful and sustainable livelihood leads to poverty, limited access could be political, socio-economic, or psychological (Saliu, Luqman, & Abdullahi, 2007). Despite the economic contribution of the region to the country's economy, they are still impoverished due to environmental effects of oil production and failure of the government to improve their living conditions. Funds are still being embezzled, sickness and diseases connected with oil production still persists (Inyang, 2012). Ross (2003) found economic volatility and dutch disease as some of the negative effects of oil.

The quest for economic survival and wide spread unemployment is a major issue in the region over the years. There are many unemployed youths and graduates roaming the streets. "The National Bureau of Statistics (NBS) revealed that Nigeria unemployment rate rose to 12.6% in the first quarter of 2016" (Njoku, 2016.p.50). It is indeed very frustrating for educated youths with relevant knowledge and technical skills to be unemployed. Most qualified people in the region do not gain from the recruitment process in the oil sector. They are therefore vulnerable and engage in unscrupulous activities like illegal refining etc. The NNPC 2015 working report estimated that 5,280 oil wells are vulnerable to vandals (Okere, 2016). There is therefore unemployment induced aggression and violent in the region resulting to insecurity of lives and oil installations. Many therefore resort to resource agitation, and illegal refining as a means of survival.

2.5.2. Resource agitation.

Militancy is the use of aggression in the pursuance of a course, usually economic and political (Inokoba & Imbua, 2010). Youths in the region have resorted to armed resource control agitation and a quest for self-determination due to years of economic neglect. Many years

before the emergence of armed youth (agitators) non-violent agitation was led by Isaac Adaka Boro & Kenule Saro-Wiwa (Odoemene, 2011). Militancy and vandalism has been the greatest challenges of oil refining in Niger Delta. It serves as a way of venting frustration and anger by disgruntled youths in the region due to environmental degradation which in turn has deprived the people the opportunity to engage in meaningful ventures. It is also a means of agitation for the government and the multinationals to implement environmental cleansing and other socio-economic compensation (Njoku, 2016). The welfare of the region has not been prioritized by both the multinationals and the government, leading to trust gap between them and local communities (Eregha, & Irughe, 2009). Militancy reduces oil production due to attacks on oil institutions as well as leads to loss of revenue to both the government and investors. MOCs staff are abducted and held hostage on regular bases and released upon payment of ransom (Ikelegbe, 2006). Many oil workers were abducted in 2006 (Iheriohanma, 2016). Duru, & Ogbonnaya (2012) notes that there have been 308 hostages taking incident from 1999 to 2007. Militancy also takes the forms of sea piracy, and vandalism. The Niger Delta Avengers is leading the resurgence of militant activities in the region. The poor in the region are both used as agent, perpetrators, and victims of environmental degradation (Broad, 1994). “The big wigs in the Federal, State and Local government in Nigeria are often behind oil pipeline vandalism and illegal refining” (Njoku, 2016, p.51).

The reoccurring bombing of oil installations led to the shutdown of operations by Shell Petroleum Development Company (SPDC) in October 2015 (Njoku, 2016). Other bombing of oil installations claimed by the Niger Delta Avengers includes the bombing of installation belonging to Exxon Mobil and Agip Oil Company in Delta, Bayelsa and Akwa-Ibom states (Abubakar, & Daku, 2016). According to Njoku (2016 p.49) “a total of 2,832 pipelines were vandalized between February 2015 and January 2016.” Thousand barrels of crude oil are stolen and also refined illegally during such operations. Electricity generation and supply are affected because the “thermal power stations depend on gas supply delivered through these vandalized pipes” (ibid, p. 53). For instance, Shell Forcados export terminal and Lagos Escravados pipeline were attacked in February 2016, 3,132 megawatts (MW) of electricity was lost as a result (ibid). According to the Nigerian Minister of Power, Works, and Housing, Babatunde Fashola, many gas fires generating turbines are dysfunctional due to vandalism (Nnodim, 2016).

Over the years, oil theft has gradually become a norm in the region. The fight against oil theft, vandalism, and bunkering has not yet been won by the government despite its security spending to arm various security outfits such as the Nigeria Security and Civil Defense Corps (NSCDC) (Ugwuanyi, 2013). The nature of the Niger Delta environment with over 33,000 creeks makes it difficult for the Nigerian Navy (NN), and the Joint Task Force (JTF) to effectively protect against pipeline vandalism, oil theft which supports illegal refining (Olaniyi 2015).

Successive governments in Nigeria have adopted the repressive method for addressing militancy. HAKURI 1 and 2, Operation Restore Hope, Joint Militancy Task Force etc. have all been set up to fight oil militancy (Ikelegbe, 2013). These operations have worsened the situation and many reported cases of human rights violation during these operation for instance there have been numerous community invasions in the region, for instance at; Odi in Bayelsa state in 1999 (Odoemene, 2011), Ohoror-Uwheru community Delta State in 2003 (Eregha, & Irughe, 2009), Yeghe community in 2016 (Iheriohanma, 2016). However, due to the raising militancy, insecurity of lives and high susceptibility of oil installations to frequent vandalism as noted by (Asu, 2016), the late Nigeria President Umar Musa Yar' Adua in 2009 initiated a dialogue process that led to the establishment of the Amnesty Programme (AP) in the Niger Delta. Some of the goals include; massive infrastructural development in the region, rehabilitation and reorientation of ex-militants, restoration of peace and stability. Some of the ex-militants were sent abroad for further studies and technical trainings; others received monthly stipends from the Nigerian government. The Niger Delta Development Commission (NDDC) was also a major recipient of funding from the 2010 budget of the Nigeria government worth billions of dollars (Njoku, 2016). The Amnesty programme brought about improved tranquility and security of both human and oil facilities and the general reduction in crime rates such as kidnapping, cultism. It also led to improved oil production. However, the program did not end vandalism and illegal oil refining because government and other stakeholders reneged in sustaining the programme. Vandalism has become more frequent in the Niger Delta from June 2014 to June 2015 according to Dr. Ibe Kachuckwu, the General Manager of the Nigeria National Petroleum Corporation (NNPC) (Njoku, 2016).

2.5.3. Communal Conflict and Social Tension

Oil explorations sometimes induce conflict and social tensions in oil producing communities (Darkwah, 2010). For instance, in the Niger Delta region, there are various agitations for; development projects, and employment. Furthermore, the question on the ownership, sharing and allocation of resources and its proceeds has often resulted to inter-ethnic conflicts. For instance, Ibeno vs Eket communities in Akwa Ibom state (Iheriohanma, 2016). Inter and intra community conflicts have claimed thousands of lives. Land disputes are common in the area since the natural resources are derived underground (Emuedo, 2010). These conflicts have led to massive killings and destruction of properties. Many historical, culture and ecological structures and artifacts have been lost due to conflict (Odoemene, 2011). There are also reoccurring disagreements over revenue sharing formula between the Nigerian government and oil producing communities (Akpan, 2010). Social values and norms are also being eroded, the youths have less regard for elders since the latter now involve in shady oil deals, thus a decrease moral value in the community. Many community leaders have embezzled funds meant of community projects to militate against environmental impact of oil.

2.6. The Emergence of Illegal Refinery as a Survival Possibility

Illegal oil refining in the Niger Delta is “semi-structural, informal, and highly entrepreneurial” (SDN 2013, p.11). The absence of equity in resource redistribution in Nigeria particularly in the Niger Delta region as well as environmental degradation and loss of livelihood from oil activities resulted to the establishment of illegal oil refinery (Iheriohanma, 2016). Factors driving the setup of illegal refineries and oil theft are multifaceted but are socio-economic and political. These include but not limited to; youth unemployment, bad governance, poverty, weak institutional structure Adegbite (2014). According to Brock (2012) marginalization, neglect, and environmental degradation forms the reason for illicit oil activities in the region. SDN (2013, p.38) notes that “illegal oil refining is perceived as an entrepreneurial free market response to local economic dysfunction, socioeconomic pressures, and government’s failure to provide basic services”. Illegal tampering with pipeline for stealing and refining crude is referred to as oil theft sometimes also referred to as illegal oil bunkering (Ugwuanyi, 2013; Asuni, 2009). The Niger Delta people feel helpless even though they acknowledged the illegality in their actions. They feel such acts are their last resort for survival (SDN, 2013).

Delta and River state has the highest production capacity of illegal refinery in the Niger Delta (ibid). The main actors that are involved in oil theft and illegal refining are divided into 3 levels (Asuni, 2009); the local level including the Niger Delta Youths (NDY), and community leaders; the government level including top politicians such as serving and retired military officers, employees of both the NNPC and other MOCs. At the international level, some countries from Eastern Europe, France, Netherlands, Senegal, Russia etc. Some of the illegal refineries are set up due to conspiracy and compromise by government officials and security agents for personal gains (Njoku, 2016). For instance, the arrest of a Brigadier General, then the commander of the Joint Task Force (JTF) in March 2006 and the arrest of a MOCs personnel in November 19, 2012 are few examples to note (Katsouris, & Sayne, 2013; Izeze, 2013). Illegal oil refining has lead to loss of lives and properties. It also drives respiratory diseases associated with the toxic gases emitted during refining activities hence, polluting the environment and contributing to climate change (Sims, Goresvski, & Anenberg 2015, p.13).

The Army, Navy and Paramilitary agencies make up the joint Task Force (JTF) set up to combat illegal oil activities as well as protect oil installations and facilities (Wilson, 2014). Confiscation of illegal refinery by the JTF causes more harm than good on the environment (Iheriohanma, 2016). For instance, the confiscation of illegal refinery in Buguma, Assari Toru local government area in River State with over 50,000 illegal refined fuels destroyed (Olaniyi, 2015). Furthermore, the destruction of 8 illegal refineries which had about 300 metric tons (MT) of crude by the Joint Task Force caused the release of lots of carbon monoxide into the atmosphere in the region thus affecting negatively on the entire ecosystem (Gabriel, 2015).

2.6.1. The Operations of Illegal Oil Refining

Illegal refineries in the Niger Delta has 5 main operational chain; tap installations, operating the tapping point, supply of stolen crude for export and local refining into products, distribution and sale of refined products (SDN, 2013). The technique for accessing crude involves the installation of tap or pipeline by operators of illegal refinery into about 1650 kilometer through welding of tabs to the legal crude supply tab of the oil company. Usually the welders used are former employees of the oil companies. Illegal refiners work in unions since it needs collaboration with various actors such as the government security personnel, oil workers, militants, etc. The union regulates the business as well as gives the necessary

protection needed (ibid). Before tapping into pipelines, the pressure on oil pipes must be reduced to avoid the risk of explosion. Some staff of MOCs who work in the pipeline control room are accomplice of illegal refining, they usually lower the pressure in the pipeline or inform vandals when pressure has been lowered for routine maintenance, normally they receive around USD 6000 as compensation (ibid). For crude to be tapped, the tapping points need high security to work. Some unscrupulous Joint Task Force personnel give cover to the illegal operators. Stolen oil is siphoned into Cotonou boats².

Supply of stolen crude for local refining and export involves moving vessels from the tapping point and transporting stolen crude to tanker stations along the coast for onward distribution both within and outside the country. Crude that are not transported are refined locally within the tapping area or camps and stored on synthetic materials underground (SDN, 2013).

The refining process involves cooking of crude.³ Some of the “typical materials required for refining camp include; land with river access, a main cooking oven, storage facilities, cooling system, drums, pipes, pumping machines and hoses” (ibid, p.15). Most of the materials used in illegal refining process are readily available in the local market, hence it makes the business to thrive without so much efforts gathering materials. Illegal refining is highly risky with potential for explosion if the oven becomes overheated. The heating process produces dense black clouds of carbon. Diesel, petrol, kerosene, bitumen, and waste products are the yields of illegal refinery (ibid, p.14). The operations of most illegal refinery are usually at night except for illegal refineries with adequate political backing from top government politicians and military personnel. The night operation reduces detection by the JTF. There are high profits associated with illegal refining, the set-up capital is just USD4700 which could be easily recovered after few illegal refining operations owners of illegal refinery could make up to USD1,038,00 monthly (ibid, p.18).

² A local name for vessels used in oil theft with 450 drum capacities also referred to as supply boat. (SDN, 2013)

³ Fractional distillation that involves heating and condensing of crude into different petroleum products (SDN, 2013)

2.6.2. Trading of Illegally Refined Products

There is a large scale illegal local and international trading on crude oil. This has grown from a few amateurs in the 1980's who utilized crude methods to extract crude from pipelines to a very sophisticated industry which uses advanced technologies to tap crude and sophisticated communications equipment to navigate through the maze of hundreds of creeks, and rivers. The oil theft syndicates have also graduated from boats and barges to ships and large oil tankers in the high seas. The stealing and smuggling of crude has become very extensive and large scale since the late 1990's (Ikelegbe, 2005).

The distribution stage is very profitable and very risky because distributors are susceptible to meet the JTF, and armed robbers who could divert their products and cash from sales. Due to the cheaper prices of illegally refined products in the local market, the demand is high as well as the turn-over. Road side black marketers sell their products in gallons especially during fuel scarcity. It is difficult to differentiate between legal and illegal products due to the high degree of distribution mix in the market. The distribution and sale of refined products is carried out through "shipment by sea to large domestic and regional markets, diesel sales to nearby towns and cities, supplying surplus kerosene within communities and personal use of diesel" (SDN 2013, p.25).

2.5. Socio-Economic Effects of Illegal Oil Refinery

Nigeria is making less revenue than expected in the budget and rising domestic and international debt due to fall in international oil prices. There is an increasing expenditure to fix vandalized pipelines (Alawode, & Ogunleye, 2011). Nigeria risk losing USD 7.29 million on daily bases (Yusuf, 2016). Also, the county experiences production shut-in due to vandalism at Forcados Export Lines, which led to operational deficit incurred by the NNPC in February and March 2016 (Njoku, 2016). Nigeria oil production has plummeted to 1.637 million barrels per day in the first quarter of 2016 (Salau, 2016). Local supply and distribution of petroleum products in Nigeria are disrupted due to illegal refiners who steal crude for local refining leading to incessant shortage and scarcity of petroleum products. Illegal refining

encourages rupturing of pipelines belonging to the NNPC, and its subsidiaries; Pipeline Products Marketing Company (PPMC) (Asu, 2016). International gas supply is also limited. For instance, some Western countries depend on gas supply from Nigeria, countries like Ghana, Togo, Benin Republic etc. through the West African Gas Pipeline (Yusuf, 2016).

MOCs have severally declared force majeure which is the “legal clause that allows a company to walk away from a supply contract-owing to theft and sabotage” (Boris, 2015, p.568). For instance, Shell declared force majeure in 2009, 2010, 2011, 2012, and 2013 respectively. Agip also followed suit in September 2013 following the disruption of its operations at Brass terminal in Bayelsa. Other attacks in the past that led to majeure include; attack on Nembe creek oil pipeline, Bodo West in Ogoniland on September 18, 2013, leading to the shot down of Trans Niger pipeline (TNP) (Alawode, & Ogunleye, 2011). According to (Boris 2015, p.569) “a total of 189 crude theft were reported on the Trans-Niger pipeline (TNP) and Nembe Creek Trunkline (NCTL) between January and September 2013”. An estimated 23,000 lost their jobs in the oil sector due to scaling down of operations by some of the oil companies such as Shell and Chevron (Yusuf, 2016).

Oil theft and illegal refinery have continuously led to increase arms proliferation and drug abuse in the Niger Delta. These drugs are used to boost the morale of youths engaged in obnoxious activities like kidnapping, piracy, vandalism and other forms of militancy and violent crimes (Wilson, 2014). More than 200 people killed between January 2013 and July 2015 from oil pipeline explosion, thus a waste of National resources (Isiguzo, & Okunbor, 2013).

2.8. Environmental Impact of Illegal Refinery in the Niger Delta

2.8.1. Emission of pollutants and Climate Change

Illegal refineries pollute the air and the entire environment. Air pollution occurs when the presence of either indoor or outdoor atmospheric gases exceeds the acceptable or prescribed quantities that are considered harmful. Abdulkareem (2005, p.95) notes that any alteration of the environment whether physical, biological, etc. that predisposes the inhabitants to various forms of health risks, or safety hazards is termed environmental pollution. Pollutants from illegal refining, contaminants the environment in multifaceted ways with far reaching consequences (Ko, & Day, 2004). In the region therefore, the quantities of atmospheric gases

exceed the stipulated level by the Federal Environmental Protection Agency (Emoyan, 2008). The Niger Delta region therefore, does not enjoy clean air which is one of the requirement for measuring health and well-being according to (World Health Organization, 2006). Air pollution besieges the region resulting from the array of industrial activities which are mostly oil related (Tse, & Oguama, 2014). Emissions such as sulfur compounds, nitrogen oxides etc. from both legal and illegal refining process constitute threat to clean air in the region (Epstein et al. 2002). The poisonous carcinogenic gases emitted by illegal refinery predisposes the community to health hazards particularly cancer and respiratory diseases (Webb et al. 2016) (Ana, Sridhar, & Bamgboye, 2009). For instance, the residents of Ogoni often complain of health issues especially asthma, bronchitis, skin rashes (Ismail, & Umukoro, 2012). In 2016, Port Harcourt recorded massive black soot that engulfed the area due to the activities of illegal oil refiners.



Photo 3: Illegal refining activity (Taylor, 2013).



Photo 4: Affected Soil by Illegal Refinery (SDN 2013, p.33).



Photo 5: Affected vegetation and water by illegal refining activities (Taylor, 2013)

Climate change is one of the consequences of the operations of illegal oil refinery in the Niger Delta region. The toxic gases emitted from illegal refining have contributed to the rise of the atmospheric temperature in the region. According to the UNFCCC (1992, p.3) “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere observable over comparable time periods could be referred to as climate change”. Put differently, Anyadike (2009, p.13) states that climate change is “a situation in which a change in the climate continues in one direction at a rapid rate for an unusual extended period.” Ugochukwu (2008) & Ozor (2009) states that climate change poses a global threat to the environment and could be easily noticed through the general increase in temperature and the rising sea level in the Niger Delta region.

Human socio-economic activities are one of the major drivers of climate change in the region as noted earlier. These activities include but not limited to the extraction and use of natural resources. For instance, burning of fossil fuel during the production process of illegal refinery emits toxic gases in the atmosphere (IPCC, 2007; Ozor, & Fodeke, 2009; Ujah, 2009; Egbule et al. 2011). A lot of work is still required in combating these socio-economic conditions that drives climate change in the Niger Delta. According to the Intergovernmental Panel on Climate Change (IPCC), delayed emission reduction increases exposure to climate change especially for developing countries (Pachauri, 2009). Paradoxically, “countries (United States and Europe) that significantly contributes to climate change do not suffer much from its effects

because of their advanced natural technologies, wealth statues, adaptive strategies, and polity” (Ozor 2009, p.22).

2.8.2. The Effects of Climate Change in the Niger Delta

2.8.2.1. Flooding

According to Ibeakuzie (2008), climate change in the Niger Delta has led to rising sea level which is the major cause of erosion in the region. Excessive rainfall within a prolonged period results to flooding. There are three major types of flooding in the region; riverine flooding, coastal flooding, and urban flooding. These flooding are caused by large volumes of rainfall, runoff water, storm surge and blockage of water ways by buildings and other urban constructions respectively (ibid, p.6). Excessive rainfall also leads to two major kinds of erosion in the region; water erosion and coastal erosion (Ibid, p.12). Erosions separate communities thereby making roads inaccessible which also hinders economic activities, it also threatens lives, properties and have rendered many homeless. Egbule (2011) notes that changes in rainfall pattern has also contributed to destruction of soil, decrease of agricultural products such as fisheries, increased pest, and crop diseases. Continues rainfall usually leads to leaching of soil nutrients. Submerging of farmlands and destruction of crops, soil erosion, and loss of soil fertility are consequences of changes in rainfall intensity and pattern in the Niger Delta region (Etim, Ituen, & Folarin, 2008). Increase rainfall and flooding leads to increased mosquitoes and malaria, water borne diseases, blockage of sewages due to improper refuse disposal etc. (Smith, 2002). SDN (2013, p.38) notes that “an urgent multi-stakeholder response is required of government, civil society and the oil majors to combine efforts to raise awareness of the health and environmental impact of illegal oil refining” Climate change also leads to shortage of safe water especially in remote villages in Nigeria.



Photo 6: Flooding in Port Harcourt (Iheamnachor, 2017).

2.8.2.2. Hunger

Climate change leads to food insecurity, increased prices for agricultural products, hunger, and reduced nutrition (Ozor, 2009). The latter affects over 850 million people globally according to German Advisory Council on Global Change reports (2007). The effects of climate change leads to decreased survival rates of fisheries, and low crop yields due to the rise of atmospheric temperature. Floods, erosion, and soil leaching affect farmlands and reduce food availability (Etim, Ituen, & Folarin, 2008). Climate change undermines reaching and sustaining the provisions of article 2 of the United Nations Framework Convention on Climate Change on ensuring food security for all. According to (McCarthy, 2001) the less adaptive a country is, the more vulnerable they are to the effect of climate change on food security.

2.8.2.3. Natural disasters and loss of lives and properties

Climate change has both direct and indirect effects (Anyadike, 2009) the former includes loss of lives, assets, livelihood, infrastructure, and food insecurity. The latter include; impairment of economic growth such as increased inequality, inability of people to engage in meaningful ventures due to limited options and resource conflict. Flooding and storms leads to loss of lives, and destruction of sources of livelihood such as farmlands, livestock's, and personal properties. Communities are separated by gully erosions which in turn affects trade and transportation of agricultural products. Acid rain destroys corrugated housing roofing sheets (Etim, Ituen, & Folarin, 2008).

2.8.2.4. Climate change and unemployment

Climate change affects livelihood particularly agriculture a vital sector in the Nigerian economy which contributes 40% to the country's gross domestic product (GDP) (Ozor, 2009). "The environmental destruction associated with illegal refining harms traditional source of livelihoods tied to land and water" (SDN 2013, p.28). Many farmers and fishers have lost their source of revenue especially inhabitants of the coastal areas in Niger Delta. Richards (2003) claims that both Africa and Latin America have experienced 30 % reduction in agricultural yields. Both continents are predisposed to sickness, hunger, over-exploitation of the left-over resources, and other social vices (Anyadike, 2009, p.15). Climate change disrupts cultivation, planting, and harvesting routines which are dependent on weather. Farmers are therefore usually frustrated by these uncertainties (Odekunle, 2004). Lengthening of crop cycles, under or over concentration of nutrient in plants, change in taste, and nutritional value of some food crops especially fruits and vegetable are more likely in the future (Ozor, 2009). Climate change either leads to excessive or inadequate rainfall. The former affects soil quality, harvesting, loss of arable land, overall reduction in crop yields and animal protein such as milk, meat, eggs. It also leaves livestock with less feeds. The fishing industry for instance, employs many people in Africa and gives one of the major sources of dietary proteins in Nigeria. According to Ozor, (2009, p.24) climate change could "alter the abundance, distribution and availability of fish population, and the migrating patterns of fish and reduce landing in the coastal areas." The general effect of climate change in Nigeria is captured below;

The South-South and South-Western geopolitical zones are affected by sea level rise and deforestation-induced changes; the South-East geopolitical zone is affected by erosion, flooding and land degradation, North-Central geopolitical zone by changes due to de-vegetation and overgrazing, North-East and North-West geopolitical zone by drought, desertification, and heat stress. (Ibid p.22)

2.9. Conclusion

The chapter reveals that the rich biodiversity of the Niger Delta is under serious threat from the activities of oil production. The emergence of illegal refinery reflects corruption and bad governance in the oil sector, which have exacerbated the socio-economic challenges orchestrated by oil. The local communities in the region are faced with the effects of climate change which include but not limited to; hunger, flooding, erosion, and resource conflict.

CHAPTER THREE: METHODOLOGY

3.0. Introduction

This chapter discusses the method (qualitative research method) adopted in the study. These include; data collection techniques, and strategies, as well as how generated data from respondents were interpreted and analyzed. It also gives insight why these methods were considered suitable, and the challenges encountered in the course of the research.

Methodology is the systematic approach to solving research problem, for instance, the procedural techniques for data collection such as interviews, questionnaires among others. Qualitative research focuses on the “human side of an issue i.e. behaviors, beliefs, opinions, emotions, etc. it is also effective in identifying intangible factors, such as social norms, socioeconomic status, gender roles, ethnicity, and religion, whose role in the research may not be apparent” (Mack et al. 2005, p1). Berg & Lune (2012, p.2) maintain that “qualitative research refers to “the meanings, concepts, definitions, characteristics, metaphors, symbols and descriptions of things”. Data collected in qualitative research are usually through in-depth interview, participants’ observation and focus group discussions. Magilvy & Thomas (2009) maintain that the focus of qualitative research is an in-depth understanding of a social phenomenon such as subjective experiences and social structure.

This study therefore, adopts qualitative research methods based on the peculiarity of the research topic and questions which borders on in-depth investigation and understanding of subjective experiences and perception on climate change mitigation. Also, qualitative method was adopted because it allows for proximity between the researcher and the study population (Berg & Lune 2012).

3.1. Research strategy

Historical research strategy was used in this study to describe and examine past social realities (events) that shapes the present situations in the Niger Delta. The approach is one among many used in qualitative research. According to (Bryman, 2004; Creswell & Creswell, 2017) different research strategy guides social research. Historical approach was used to unravel the socio-economic and political factors that contribute to the emergence of climate change in the

region. Also, the procedures and process for data collection in a research is embodied in the research design (Magilvy & Thomas 2009). The emphases of this approach are not on quantifying these factors but more of textual presentations as noted by (Punch, 2013).

3.2. Sampling design

Purposive (non-probability) sampling was used in this study, to ensure that only those relevant to the research are strategically selected as observed by Bryman (2016, p.408) In other words, participants were sampled purposefully to be able to provide answers to the research questions bordering on the perception of the local community on mitigation of climate change, and make inferences applicable to the larger group. Purposive sampling proves to be the most suitable as shown by (Berg & Lune, 2012; Jørgensen & Phillips, 2002). Purposive sampling refers to the choice of study participants according to “preselected criteria relevant to a particular research question” (Mack et al. 2005, p.5). Consequently, members of the local community resident in Port Harcourt formed the population sample, this is because illegal oil activities are usually perpetrated by them, also they are the most vulnerable group to the effects of climate change, hence the reason for their purposive selection in the study for in-depth understanding of the situation in the region (Moser & Stein, 2010). Sampling is important in this study because of the non-availability of adequate resources to cover the entire population.

3.3. Data collection methods

Data was collected from 12 respondents’ residents in Port Harcourt, Niger Delta, using semi structured interview. Semi-structured interview was used because the research is focused on the subjective experiences of respondents, thus, this enabled the capturing of respondents’ in-depth insight on mitigation of climate change via modular refinery. It is also highly flexible as it allows for open ended responses and follow-up questions as shown by (Rubin & Rubin, 2005; Berg & Lune 2012; Bryman, 2016). Data generated in this study was voice recordings during the interview process via an audio recording device in line with Mack et al. (2005, p.1) observations. The interview period lasted for a couple of days as it was not possible to get all the respondents in one day. Secondary data also forms part of the relevant literatures in the study. Bryman (2008) referred to secondary data as data in the related topic already collected by other researchers. Data source includes; Nigeria newspapers, research journal publications,

scholarly articles, websites of international organizations like the UNFCCC and IPCC, reports on the Niger Delta etc. Data collection from the field is interesting because it exposes differing world views of respondents on the same issues. Majority of the research respondents were very impressed with the topic as it directly deals with issues confronting them.

3.4. Data analysis

Hsieh & Shannon (2005, p.1) notes that content analysis is the interpretation of meaning from textual data. It may involve three approaches; conventional, directed or summative. These approaches involve coding of data, the use of theories for analysis and interpretation. Elo & Kyngas (2008, p.107) notes that content analysis may be used inductively or deductively in either quantitative or qualitative studies in analyzing phenomenon and documents. These documents could be either written text, verbal or visual communication messages. The data gathered were transcribed. Transcription involves the conversion of recorded voice from the interview into words in an exact way it was said. Furthermore, replication and inferences from data to the context is possible when this method is adopted. Content analysis has three major phases; “preparation, organizing, and reporting” (ibid, p.107).

This study is based on deductive approach. “Deductive content analysis is used when the structure of analysis is operationalized on the bases of previous knowledge” (ibid). The application of deductive analysis is used in a research that involves moving from general to specific application of theory. Coding and categorization could be based on “earlier work such as theories and literature review” (Polit & Beck 2014). The theory used in this study was applied to a different context (Niger Delta region) it also serves as guide, and gives focus to the study.

In this study, the generated data was coded based on the major concepts derived from the ancillary theory of climate change mitigation such as; costs, benefits, baseline, opportunity costs etc. Transcribed data were colour coded in relation to the research question and theoretical framework. Colour coding refers to the process of assigning distinct colours to transcribed interview responses to form categories (Berg & Lune, 2012). Similar data were merged in the same group forming a sub-category, while related sub-categories were merged into main categories. Coding and categorization led to the creation of model for enhancing the interpretation and comprehension of the study findings. (See appendix 1).

3.5. Triangulation

Data source triangulation was used in this study. Cohen & Crabtree (2006) notes that triangulation involves “using multiple data sources in an investigation to produce deeper understanding. It ensures that an account is rich, robust, and comprehensive. A single method can never adequately explain a phenomenon”. There are three major types of triangulations; data source triangulation, method triangulation and theory triangulation (ibid). Multiple sources of relevant secondary data were used to verify the information provided in the study to ensure credibility, and the avoidance of lopsidedness as observed by (Yin, 2003). For instance, the sources of literature review were drawn from academic journals, newspaper publications, official websites of international organizations, photographs from previous related research etc. These sources support the research argument regarding the link between oil production, environmental degradation, weak institutions, loss of livelihood, the emergence of illegal refinery and its consequent contribution to climate change in the Niger Delta. Triangulation also ensured that the basic elements of trustworthiness which are; credibility, transferability, dependability, and confirmability are ensured (Shenton, 2004). The research is credible and justifiable because it gives the needed evidence for the information provided therein, in other words, the internal validity and credibility is assured. Other researchers can confidently rely on this study when conducting a related research. Also, the findings can be replicated i.e., reliable and dependable (Ritchie, Kewis, & Nicholls, 2003).

3.5.1. Credibility

Data were obtained from multiple sources for instance the literatures were drawn from different scholars, and data were generated from different respondents to make the study nuanced, generated data were also cross examined. A credible research must also ensure that findings are drawn from generated data. The findings of this study are credible based on the above.

3.5.2. Transferability

Transferability in qualitative research entails external validity in quantitative research (Shenton, 2004). It deals with the applicability of a study to similar context or situation. The research could be applied to any oil producing context which experiences similar environmental and climate change due to human activities. It is important to note that qualitative research usually covers small sample size which may not be demographically representative, hence applicability limited (Denscombe, 1998; Bryman, 2008).

3.5.3. Dependability

Dependability in qualitative research entails reliability in quantitative research (Shenton, 2004). Proper documentation of the research process ensures the possibility of replication by other researchers when conducting similar research. The findings of this research could be depended on for future studies. This could be possible because all the research processes, phases, and sources were all documented and could be easily accessed for future use (Bryman, 2008).

3.5.4. Confirmability

The ability of a researcher to maintain neutrality or jettison all forms of bias and personal sentiments which would militate on the actual findings or information's from respondents and the research at large (Shenton, 2004). Therefore, this research is devoid of personal sentiments or interest. According to (Bryman, 2008) it is difficult for a researcher to keep complete neutrality in social research; effort was therefore made to ensure that this study is devoid of bias.

3.6. Ethical considerations

The purpose of the research was presented to the respondents in an open and honest way (Scheyvens, Nowak, & Scheyvens, 2003). The need for social scientist to seek informed consent from research participants before they are involved in a study, as well as ensuring their privacy and confidentiality of data are fundamental as noted by (Berg & Lune, 2012; Bryman, 2016). "Informed consent is a mechanism for ensuring that people understand what it means to

participate in a particular research study, so they can decide in a conscious, deliberate way whether they want to participate” (Mack et al. 2005, p.9). Informed consent would ensure adherence to the three core ethical principles of; respect for persons, beneficence, and justice. The former ensures the autonomy of research participants, and protection from exploitation, and vulnerability. Beneficence deals with maximizing participants’ gain and risk minimization whether physical, psychological, or social. Justice deals with fairness of risk and benefit distribution to participants (ibid). The aim of the research was explained to the participants to convince them on the need for their participation in the research. Cited literatures were also referenced to avoid plagiarism (intellectual theft). Plagiarism involves the use of ideas from earlier research without acknowledging the owner of the original idea (Mack et al. 2005; Locke, Spirduso & Silverman, 2014).

3.7. Limitations and challenges.

Some participants lacked the confidence to grant interviews as this was an unusual experience, others were either skeptical or scared to express their opinions for personal reasons, this made the generation of data from respondents to last longer than anticipated. However, overall most participants found the study interesting and volunteered.

3.8. Conclusion

This chapter shows the synergy of the research question and the research methods adopted in this study. To answer the research question which deals on subjective experience, qualitative research methods were used in the study. The research design is historical to connect past and present social realities; data source triangulation was used to ensure the robustness of the historical account. Primary data were collected via semi structured interview using an interview guide. Content analysis was used in analyzing the generated data from respondents. The method places high priority on ethical consideration to ensure respect, beneficence, and justice for the respondents.

CHAPTER FOUR: THEORETICAL FRAMEWORK

4.0. Introduction

This chapter discusses the theoretical framework adopted in the study. This study is guided by the application of the general theory of mitigation to a specific context (Niger Delta Region). The choice of theory, which is *ancillary costs and benefits theory of climate change mitigation*, is because it is consistent with the aim of the research, i.e. to find out the perception of the local community on the costs and benefits of climate change mitigation. Furthermore, it is consistent with the method of data analysis i.e. deductive content analysis, because the application of deductive content analysis is used in a research that involves moving from general to specific application of theory Elo & Kyngas (2008).

4.1. The Ancillary Benefits and Cost Theory of Climate Change Mitigation

Ancillary benefits and costs theory of climate change mitigation “focuses on the effects other than the reduction in GHGs emissions, which occur indirectly because of those reductions” (Krupnick, Burtraw, & Markandya, 2000, p.4). Put differently, “ancillary mitigation benefits and costs are externalities arising from GHGs abatement policies that are achieved jointly with the reduction of GHGs in the atmosphere” (ibid, p.1). As shown by Pearce (2000, p.1) the “benefits which accrue as a side effects of targeted policies are known as secondary benefits, or policy spillover effects, co-benefits or ancillary benefits”. According to the (IPCC, 2014; Vuuren, 2006) climate mitigation policies usually have spill-over effects on other aspects of the environment. Glomsrød, Vennemo, & Johnsen (1992) are one of the earliest proponents of ancillary benefits of climate change mitigation.

4.2. Rationale for Participatory Mitigation

When the estimated benefits from climate change mitigation is perceived as higher than the high cost of climate change mitigation, the parties involved would more likely swing into mitigation actions and activities. When the cost is deemed higher than the benefit of reducing GHGs, the motivation and eventual mitigation action would likely be ignored. “Most of the key ancillary costs and benefits are relatively short-term and most of the benefits are local i.e.

they affect the communities relatively close to the source of policy or program” (Krupnick, Burtraw, & Markandya, 2000, p.2). The benefits of climate policy are long term and have a global effect. The cost of climate policy is incurred at the local or national level within the authority of those enacting the policy (ibid).

4.3. Ancillary Benefits, Costs and Opportunity Cost of Mitigation

Climate mitigation involves an opportunity cost. The parties involved such as the government, MOCs, and the local communities, would have to make sacrifices in a bid to enjoy improvement in health and environmental conditions. For instance, transitioning from carbon economy by OPEC member countries and other countries who generate enormous revenue from oil such as Norway, would lead to decline in their foreign earnings. Therefore, the wealthier a country is, the higher the opportunity cost (Schurr, 1984). Ancillary benefits include; improved ecosystem and agricultural productivity, improved air quality, reduction in industrial and transportation pollutants as well as reduction in mortality and mobility from pollutants (Krupnick, Burtraw, & Markandya, 2000). The benefit of emission reduction may either be felt within the same period the cost was incurred or in the future” (ibid p.2). Example of ancillary cost of mitigation include; an increase in pollution due to an increase in price of clean or renewable technology resulting from mitigation policies. People may revert to cheaper traditional source of energy such as wood. Furthermore, when the cost of setting up modular refinery is very high, people are likely to return to illegal refining, hence a continuation of vandalism, militancy, and oil theft, especially if ex-militants are not fully employed or integrated in the mitigation program. Negative effects may also arise from reduction of pollutants (Wiener, 1995). For instance, if mitigation leads to increased employment and income, it may also lead to increased health problem like alcoholism etc. This is because change in income usually leads to change in behavior and mental health (Viscusi, 1994). Some members of the local community who still have farmlands may abandon them to secure jobs in modular refining thus creating further food insecurity.

4.4. Why Participatory Mitigation is Eminent

The movement of pollution knows no boundaries. It cuts across distinct cultures, economies, and societies; it usually emanates either locally or regionally. However, mitigation is usually

concentrated in areas or sectors affected the most by climate change if the envisaged ancillary benefits are significant (Krupnick, Burtraw, & Markandya, 2000, p.3). Information dissemination on ancillary benefits may affect behavior and the amount of resources that would be dedicated to climate mitigation (Pearce, 2000). The larger the benefit the more push from interventionist to speed up of climate mitigation.

4.5. Estimation of Mitigation Costs and Benefits

Estimation of ancillary benefits may “vary significantly in different countries, due to the type of climate change mitigation policy being considered, each decides on how to achieve their agreed commitment to carbon reductions based on ancillary cost-benefit of alternatives actions” (Krupnick, Burtraw, & Markandya, 2000, p.8-22). The ancillary benefits and cost from mitigation may sometimes either be over or under estimated. For instance, the benefit of pollution reduction may be under estimated in developed countries since they do not have known severe pollution crisis. The opposite is the case for developing countries. Compelling evidence that pollution reduction would lead to increased environmental and health benefit and climate improvement may lead to overestimation of mitigation benefits. It could be over estimation of mortality and morbidity benefits, ecological resource benefits, agricultural benefits etc. (Krupnick, Burtraw, & Markandya, 2000). Estimation of ancillary cost and benefit is more difficult in developing countries due to lack of data, technology, internet, good record system etc. Most estimates used are transferred from studies in developed countries which is usually in monetary terms. Consequently, resulting to either over or underestimation of cost or benefits (Navrud, 1994).

4.6. Mitigation Situation in Developing Countries

Developing countries usually have higher non-mitigation priorities such as poverty alleviation, employment creation, rather than on mitigation of climate change. The latter is seen as secondary in government policies and programs (Krupnick, Burtraw, & Markandya, 2000). Policy makers in these countries are more concerned with the short and medium-term ancillary benefits than long-term benefits which have many uncertainties to ascertain. Pearce (2000, p.35) notes that “ancillary benefits can also justify acceleration of climate policies since the ancillary benefits are likely to occur in near time than climate change benefit”. Hence, there is

a need for climate policy abatement especially in developing countries to take cognizance of the cost and benefit of mitigation (Pearce, 2000).

4.7. Mitigation Baseline

According to (Krupnick, Burtraw, & Markandya , 2000, p.12) “the assumption of the emission that would occur in the absence of a mitigation policy is referred to as baseline.” Emission refers to “the release of greenhouse gases and or their precursors into the atmosphere over a specified area and period (UNFCCC 1992, p.3). It is extremely important to achieve a consistency in baseline assumptions among studies that influence the policy debate or at least to make the implications of their differences explicit” (ibid). The baseline in the Niger Delta would be continues deteriorating climate, and environmental degradation, increasing mortality and morbidity in the region, and increased illegal refining activities, militancy and vandalism etc. Climate change policy “may affect the cost of existing regulations” (ibid p.9). For instance, the existing regulation only permits the operation of traditional refineries in Nigeria; the proposed introduction of modular refinery is a new initiative in the country.

Ancillary cost and benefit theorists differ in their study focus and agreement on ancillary benefits. For example, support for the high benefits of ancillary benefits as primary benefit of mitigation in the UK and Norway (Pearce, 1992). Burtraw et al. (2003) maintained that ancillary benefits are trivial when compared to primary benefits of mitigation which is the reduction of GHGs. (Burtraw, & Toman, 1997; Burtraw et al., 2003) focused on the monetary estimates and benefits from emission reduction and control and employment impacts. (Ayres & Walter, 1991; Ekins, 1995; Ekins, 1996) conducted studies on ancillary benefits in the 1990’s focusing mainly on Europe. (Lee, Krupnick, & Burtraw, 1995; Bernow, et al 1995) conducted studies that examined environmental public health, agricultural externalities from generation of electricity via fuel.

4.8. Illustrative Framework for Mitigation Costs and Benefits

Krupnick, Burtraw, & Markandya (2000, p.5) illustration on whether a mitigation policy is a potential ancillary benefit (+) or cost (-) by context and circumstances;

Reduction of pollution when fossil fuel use is reduced (+); Increased availability of recreational sites when reforestation program is introduced (+); Increases in household air pollution relative to a baseline when electrification rates are reduced (-); Increase in technological efficiency when modern technologies are adopted, and units cost fall (+); Increase in welfare when a shift to carbon taxation and a reduction reduces unemployment (+); Reductions in road-use related mortality when a shift from private to public transport takes place (+); Increase in employment resulting from GHGs projects where there is excess supply of labor (+); Decline in employment due to decrease economic activity resulting from cost associated with GHGs projects (-); Savings in household time in poor rural households when fuel wood use is replaced by renewable energy (+); Reduction in electricity use resulting from higher electricity prices that cause less use and thereby reduce educational opportunities for children (-).

4.9. Conclusion

The major components of the ancillary theory of climate change mitigation were examined in piecemeal. The way in which the theory was examined ensures easy comprehension of the basic tenets of the theory which guided data analysis. Ancillary theory shows that mitigation has both positive and negative consequences, and public participation in mitigation process would be influenced by their perception of the costs and benefits.

CHAPTER FIVE: MITIGATION OF CLIMATE CHANGE IN THE NIGER DELTA

5.0.Introduction

This chapter provides both the global and local background of climate change mitigation. Firstly, it looks at two key institutions that champion mitigation, their historical evolution and their efforts towards ensuring that mitigation against global climate change is achieved. Secondly, it provides the necessary background information on the operations and structures of the mitigation medium (modular refinery), aimed at facilitating the understanding of the mitigation pathway in this study.

5.1. Background of Climate Change Mitigation (UNFCCC, and IPCC)

The UNFCCC established the intergovernmental framework to address climate change. The UNFCCC was set up in 1992 by several countries in a bid to work together in limiting average global temperature increases and climate change. The convention became operational on 21 March 1994. A more binding Kyoto protocol in 1995 followed next. The aim of the UNFCCC is to “achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (UNFCCC 1992, p.4). Since its establishment, there has been an increase global response on climate change. For instance, the establishment of new institutional mechanisms, creation of international carbon market etc. Barker et al. (2009, p.37) claims that “the UNFCCC remains the main multilateral forum focused on addressing climate change with nearly universal participation. Other institutions organized at various levels of governance have resulted in diversifying international climate change cooperation’s (IPCC 2014, p.30). There are different international climate change cooperation’s and projects, they differ in their focus (IPCC 2014). For instance, “multilateral agreements, harmonized national policies and decentralized but coordinated national policies, as well as regional and regionally coordinated policies” (IPCC 2014, p.30). Another example is the setup of the Climate and Clean Air Coalition (CCAC), which is one of the drivers of international efforts on climate change mitigation (Climate and Clean Air Coalition, 2014). Global mitigation costs would be reduced with an increased global collaboration and corporation, in addition to increase mitigation effectiveness Barker et al. (2009). Also, “many climate policies can be more effective if implemented across geographical

regions” (IPCC 2014, p.30) hence setting up a modular refinery would be most suitable climate policy in the Niger Delta region.

The IPCC findings in 2007 have also facilitated global awareness and response on the impact of climate change and the imperatives of mitigation (Ujah, 2009). The Intergovernmental panel on Climate Change (IPCC) was the brainchild of the UNFCCC 1992 Earth Summit in Rio, Brazil. The aim was to ensure the reduction of greenhouse gases by governments. The IPCC was endorsed by the G-8 and the BRIC (Brazil, Russia, India, and China) in 1995 (Ujah, 2009). Achieving a maximum average temperature of 2 degrees is the emission reduction target as stipulated by IPCC Fourth Assessment Report (Buckle, Headquarters, & Mauverney, 2008). It is important to note however that climate change mitigation would pose more difficulty to developing countries whose economy are dependent on fossil fuel (UNFCCC, 1992). It is also difficult to achieve the Millennium Development Goals (MDGs) in the presence of climate change (Unies, 2007).

5.2. Mitigation in the Niger Delta region

Mitigating climate change in the Niger Delta requires effective and sustainable climate policies that take cognizance of the local context. O’connor (2000, p.2) refers to climate policy as any “set of policies whose primary purpose is to slow down the growth of net greenhouse gas emission.” Mitigation in the Niger Delta and beyond may require “the use of modern technologies, clean energy sources, change in people’s behavior, or ensuring that older technologies are more energy efficient” (British Broadcasting Corporation News 2014, p.1). Sims, Goresvski, & Anenberg (2015, p.14) states that “the most promising mitigation opportunities in a given region depend on local circumstances, such as the major sources of black carbon emissions and the feasibility of each individual technology and social mitigation strategy and policy”. The implementation of mitigation measures would improve the conditions in the region in terms of health benefits such as; cleaner air quality and reduced expenditures on treatment of respiratory infections and diseases, the economic benefit may include; “energy security, improvement in trade balance, provision of modern energy services to rural areas, sustainable agriculture and employment” (Barker, 2009, p.13). Reducing pollution in the Niger Delta would also contribute to the actualization of the 2050 target of reduction of global carbon emission (Ujah, 2009). However, most developing countries like

Nigeria do not have or adhere to strict air quality regulations, thus leading to increasing emission (Sims, Goresvski, & Anenberg 2015). Non-adherence to climate mitigation regulations may lead to severe consequences. (IPCC 2014, p.5) shows that “some mitigation action could undermine action on the right to promote sustainable development and on the achievement of poverty eradication and equity”

5.2.1 Previous Mitigation Studies in the Niger Delta

The Federal Ministry of Environment of Nigeria (FMEN) enacts policy framework and programmes on climate change aimed at meeting the provisions of the Climate Change Convention (CCC) and the Kyoto Protocols (KP) (Egbule, 2011). Many research and public campaign has been carried out by different non-governmental organizations (NGOs) and Civil Society Groups (CSG) to compliment the effort of the government. For instance, studies on “coastal management and adaptation to climate change” (Etuonovbe, 2008); mitigation of climate change impact in the Niger Delta (Akinro, Opeyemi, & Ologunagba, 2008); the impact of climate change to women’s socio-economic status and their vulnerability to poverty (Chinweze, & Abiola-Oloke, 2009); tailoring urban planning to meet the challenges of climate change (Olujimi, 2007); gas flaring effects on crops such as cassava, pepper, shows that the further away these crops (Dung, Bombom, & Agusomu, 2008); perception of Niger Delta residents on gas flaring (Edino, Nsofor, & Bombom, 2010). The Community Research and Development Centre (CREDC), Environmental Rights Action (ERA) focus on research and creating awareness on the relationship between gas flaring, climate change and poverty (Uyigie, & Ogbeibu, 2007). The 2009 conference on climate change and the Nigerian environment organized by the department of Geography, at University of Nigeria Nsukka (UNN) is another example of efforts to brainstorm and come up with local solutions on climate change mitigation. Studies on the ancillary cost and benefits of mitigation via modular refinery in the Niger Delta are still at nascent stage or nonexistence at present.

5.2.2. Modular Refinery: A Mitigation Pathway

Modular refinery is a “processing plant that has been constructed on skid mounted structures. Each structure holds a part of the entire process plant and through interstitial piping the components link together to form an easily manageable process” (Adefarati & Chigbu 2017,

p.1). Modular refinery could be considered as new and better technology compared to illegal refinery, as shown by (Buckle, Headquarters, & Mauverney, 2008, p.4). The choice for modular refinery as a mitigation pathway is based on environmental, social, and economic considerations as stipulated by the (UNFCCC, 1992)

Modular refinery would lead to an overall reduction in the emission of criteria pollutants; furthermore, it would also supplement the production capacity of the traditional refineries (Adefarati & Chigbu, 2017). Most importantly, it would serve as a climate mitigating tool especially in the Niger Delta. Ifedobi (2016) claims that modular refinery suits emerging economies due to their stage or level of infrastructural development. Conventional refineries are difficult to maintain, hence underutilized in these countries. The prevalence of poor industrial ethics and lackadaisical maintenance culture in managing large industrial plants, make modular refinery a more beneficial option. The manageability of modular refinery makes it more suitable for the Nigerian economy. Fabrication, erection, disassembling and reassembling is relatively easier. They could also be spread out in various areas in the country. Furthermore, modular refinery requires low maintenance cost. It covers less area and parameters compared to conventional refineries, hence, monitoring and securing would be relatively easier. Involving most of the indigenes in the operations of these refineries would enhance the protection of facilities from vandalism, since the people would benefit from the refineries as opposed to conventional refineries which is seen as belonging to MOCs and the government. Modular emits less toxic gases when compared to illegal refineries. Presently, there are little indications that Nigeria has evolved and capable of managing large scale industrial plants (ibid).

To address the environmental issues in the Niger Delta and meet other socio-economic challenges such as fuel shortages, the government of Nigeria in 2016 proposed to issue 25 refining licenses to indigenous companies for the establishment of both conventional and modular refineries (Adeosun, & Oluleye, 2016). The new refineries will have the refining capacity of estimated 1.6 million bpd. The Joint Taskforce Commander, Major General Emmanuel Atuwe claims that legalizing modular refinery would address the issues of unemployment which leads to vandalism and oil theft; it would also increase the availability of petroleum products to meet both local demands, and in West Africa (Adeosun & Oluleye, 2016). These refineries will be sited near the sources of crude this would be in the Niger Delta.

Dangote refinery is one of the conventional refineries expected to commence operations cum 2019 with an estimated 650,000bpd, bridging the supply gap of 53,000bpd in the country (ibid). It is estimated that Nigeria will supply 6 Million liters of refined crude to West African countries in 2019.



Photo 7: Modular Refinery. (Nigerian Investment Promotion Commission)

5.2.3. Structuring of Modular refinery

Refineries come in different shapes and sizes, from simple, small, and sophisticated. They are usually made up of many processing components or units (Kane, 2006). The three-basic petroleum processing phase include; “separation (fractional distribution), conversion (cracking and rearranging the molecules), and treatment” (Ogundari 2016, p.4). Modular refinery can be structured in two ways: traditional model or special purpose vehicle model.

Traditional Model: The marketer partners with an upstream company which has an onshore marginal field. The upstream company provides land and feedstock and a sharing ratio is agreed

upon on sales of refined products. Key players involved in structuring the deal include; transactional advisors, banks, regulars etc. *Special Purpose Vehicle Model*: The marketer and upstream company create a refinery company and share profits based on sales made by the refining company. Key players are similar with the traditional model (Adeosun & Oluleye 2016, p.14)

5.2.4. Regulation of Modular refinery

The Ministry of Petroleum Resources (MPR) set the policies and regulations of the oil industry. It also handles all application and fees relating to obtaining operating license either to; construct, operate, expand, or modify an existing refinery. The Department of Petroleum Resource (DPR) directly handles the establishment of petroleum refining per section 9 of the petroleum act (Adefarati & Chigbu, 2017). The objectives, general guideline, and requirement for the establishment of modular refinery as prescribed by the Ministry of petroleum resources in May 2017 include to promote; “availability of petroleum products in the country; to conserve foreign exchange utilization for the importation of petroleum products; socio-economic development to stop restiveness, illegal refinery activities; to mitigate and eliminate environment degradation from these illegal activities” (ibid, p.3).

Some of the general criteria to be meet by potential investors include; an updated financial account for three-year period, financial plan, proof, and sources of funding as well as tax certificates, also, evidence of registration from the Corporate Affairs Commission (CAC). Investors are expected to show their Corporate Social Responsibility plan (CSR), Health, Safety and Environmental (HSE) plan etc. They are required to provide evidence that the local human and material resources would be maximized (local content). Lastly, they need to obtain three licenses; License to Establish (LTE), Authority to Construct (ATC), and License to Operate (LTO) (ibid). Newly established modular refineries are expected to enjoy exemption from paying certain taxes as provided by the Companies Income Tax Act (CITA), the incentive would encourage the morale of investors. Currently, 23 licenses is alleged to have been made available by the federal government of Nigeria for the establishment of modular refinery, with approval for 56 companies already in place (ibid). The initiative to established modular refinery in Nigeria has also received international support in the form of grant. The United

States through its Trade and Development Agency (USTDA) “has approved USD 1 million grant for the detailed engineering design of a 20,000bpd modular refinery in Lagos” (ibid, p.5)

5.3. Conclusion

This chapter provided the background information on the key climate change mitigation institutions (UNFCCC and IPCC) which is essential in understanding mitigation. It also examined the objectives and operational mechanism of modular refinery. It shows that the mitigation medium is still a novel idea in the Niger Delta region and Nigeria in general. Hence, research gaps by previous climate change mitigation studies. The chapter suggests that mitigating pollutants (GHGs and Short-Lived Climate Pollutants⁴) from illegal refining activities which drives climate change would have enormous benefits. According to Pearce (2000, p.2) “clearly knowing the size of ancillary benefit has immense potential significance for various aspects of policy”.

⁴ Toxic gases that disappears fast from the atmosphere leaving behind severe climate consequences (CCAC, 2012)

CHAPTER SIX: FINDINGS AND DISCUSSIONS

6.0. Introduction

This chapter presents the study findings from interview with respondents guided by preselected semi structured questions on the interview guide. The discussion of these findings give meaning to the research because it then provides the bases for answering the research question, which is the perception of the local community on the ancillary costs and benefits of climate change mitigation via modular refinery in the Niger Delta. The local communities in Port Harcourt are faced with the challenges of climate change resulting partly from illegal refining. The area is highly polluted from black carbon and other toxic gases, hence predisposes the people to various health and environmental risks. Successful mitigation of climate change would need the participation of the local community in the Niger Delta region. Also, mitigation should be ethical to ensure that it does not create more damage to the climate system and the environment as well as the wellbeing of people and their cultural values (IPCC 2014). The research question and theoretical perspective serves as a guide in this chapter. The data gathered revealed two sets of respondents, mitigation optimists and pessimists.

6.1. Acceptability of Modular Refinery as a Mitigation Pathway

From the interview with respondents, the study found that most members of the local community are optimistic on the proposed introduction of modular refinery as a climate change mitigation pathway in the region. Firstly, due to their experiences with pollution from illegal refineries, and the high impact of climate change in the area. Also, modular refinery is important since the region has a high concentration of refining activities because of enormous crude deposits. Thus, the region suffers more from the impact of oil refining activities. One of the respondents noted that *“we have pollution everywhere, in our water, the foods we eat are no longer safe, after washing you see particles on the clothes.”* Therefore, the optimists in the local community perceive the benefits of mitigation to be higher than any associated cost. According to Sims, Goresvski, & Anenberg (2015), the closer the proximity of people to the sources of emission, the more they are potentially exposed to the risk and effect associated with the pollutants *“the most promising mitigation opportunities in a given region depend on local circumstances, such as the major sources of black carbon emissions (ibid p.14; UNFCCC*

1992, p.4). Respondents maintained that climate change causing pollutants affects everyone in the community, hence the need for all to take part in the mitigation process. According to Sims, Goresvski, & Anenberg (2015) pollution knows neither boundaries nor cultures. The data gathered therefore shows that there would likely be a high sense of participation and cooperation by most members of the community on mitigation policies and program in the region.

6.2. Mitigation Priorities of Policy Makers

The interview reveals that the proposed mitigation policy signals that government may be rising to its responsibility of tackling the long neglected environmental issues in the region. Sims, Goresvski, & Anenberg (2015) states that developing countries usually have higher non-mitigation priorities such as poverty alleviation, employment creation, rather than on mitigation of climate change. Political campaigns and electoral debates do not reflect prioritization of mitigation. Some of the respondents are pessimistic about the proposed introduction of modular refinery. One of the respondent's states that *"419 politicians has been talking but that is just fallacy"*. They note that just like the experiences from the operations of conventional refineries, the local community may not benefit from the mitigation process which include; ownership and employment in modular refineries. Hence, mitigation may reflect the agenda of some political elites. Data gathered revealed that respondents who are opposed to the idea prefer the existing condition in the region, which they have adapted to and also benefits from. Sims, Goresvski, & Anenberg (2015) referred to such situation as baseline; when prevailing conditions remain the same i.e. the absent of mitigation policies. Few respondents maintained that illegal refining sustains many household and some people have moved up the social strata out of poverty. From the interview with the respondents, the study found that pessimism among some members of the local community reflects trust gap that exist between the people and the government and MOCs. Many years of renege promises and social contracts, poor governance and weak institutions have characterized the relationship between the parties (Eregha & Irughe, 2009; Balouga, 2009). The government must therefore rise up to ensure that trust is restored to the public, without which mitigation may not yield the desired results.

6.3. Environmental Benefits of Mitigation in the Region

Respondents identified various environmental benefits that would likely emerge from mitigation. These include reduction of oil spillage from illegal refining activities which rely on vandalism and tapping as a source for accessing crude. As shown in the literature review, Ibaba & Olumide (2009) noted that some oil spills are caused by vandals engaged in illegal refining. Other perceived benefits by respondents include; reduced incidence of diseases and death from water contamination. As shown by Aghalino & Eyinla, (2009) there is increased severity of such epidemics in the region due to pollution from oil activities. Interview also revealed that most food consumed in the region are imported from other states in the country and even abroad due to the contamination of the environment by illegal oil refining activities, hence, mitigation would eventually improve the necessary conditions required for agricultural activities which is one of the major sources of livelihood of the community. Furthermore, hunger and food insecurity prevalent in the region as observed by (Ozor, 2009) would be addressed. Improvement in agricultural activities and productivity was also named as one of the benefits on mitigation. Gradual restoration of the pattern of rainfall would lead to increased predictability of rainfall which is important to farmers in deciding on when to embark on planting of crops, harvesting, and other agricultural activities (Etim, Ituen & Folarin, 2008).

6.4. Socio-Economic Mitigation Benefits

Most respondents maintained that modular refinery would lead to increase per capital income in the community, thereby reducing acute poverty. As shown earlier in the literature review, the unemployment rate according to Njoku (2016) stands at 12.6%, this could be reduced through mitigation as more locals would be employed to work in modular refineries across the region. The study also found that increased employment rates would invariably lead to reduction in illegal oil activities such as unemployment induced aggression and violence expressed through militancy. The outcome therefore, would translate to improved security of lives, properties, oil installations and stability of operations by MOCs, the region would also likely attract more investors in the absence of hostage tacking, kidnapping and other forms of abductions (Duru & Ogbonnaya, 2012). Respondents reported to have lost so many loved ones

who died either because of pipeline explosions or during open fire exchanges with the Joint Task Force. The few lucky individuals, who narrowly escape death, are nursing various kinds of injuries. Hence, there would be reduced loss of manpower in the region when less people are unemployed

6.5. Overestimation and Underestimation of Mitigation Benefits

The high optimism shown by most of the respondents indicates a tendency of overestimation of potential socio-economic and environmental benefits. Interview revealed that the people anticipate immediate improvement in climatic conditions once modular refinery are established. However, illegal refining is not the sole driver of climate change in the region, gas flaring etc persists. Hence, this factor may contribute to delay in the manifestation of mitigation benefits in the region. Overestimation of potential benefits could lead to frustration when expectations are not met within a brief period. Lack of data or requisite technology may also hinder the people from tracking mitigation progress (Navrud, 1994). Overestimation of benefits within an expected short time frame could be as a result of environmental baseline i.e. when the benefits from mitigation are not felt at the same time of mitigation. For instance, reduction in air pollution may not immediately result in de-acidification of the soil or reduction in mortality or morbidity caused by illegal refining. In other words, modular refinery may reduce or end illegal refining and the associated pollution but may not necessary and promptly address every pre-existing environmental and climatic issue in the region. The study also reveals that the pessimists are more likely to underestimate the benefits of mitigation due to their doubt and lack of trust in the government.

6.6. Information Dissemination a Catalyst to Increased Involvement in Mitigation

The study found that most members of the local community are willing to denounce involvement in illegal refining as their contribution to climate change mitigation if they are assured to benefit from the exercise. They are disposed to provide useful information to the security agencies on any persistent (suspected or observed) illegal refining activities. Also, they are disposed to acquire new skills needed for transitioning to legal refining. Hence, information dissemination is vital in mitigation process (Pearce, 2000). The local community need to understand that not all mitigation benefits can accrue in the short term as noted earlier.

Once this information is passed and understood by the people, it would ensure solidarity, active participation, patience and faith in the whole mitigation process. Therefore, access to information is very important in ensuring mass participation by members of the community.

6.7. Opportunity Costs of Mitigation

Schurr (1984) maintained that climate change mitigation involves an opportunity cost. As discussed earlier in the literature, illegal refining is a very lucrative business albeit very risk (SDN, 2013). The study found that members of the local community who engage in illegal refining would have to forfeit the fast and profitable revenues from their inimical enterprise, as part of the transitioning process to a more legitimate business. A respondent maintained that *“because of no employment, youth find it easier for them to make ends meet through illegal refining”* One of the reasons for the lucrative nature of illegal refining is that operators do not pay taxes or royalties to the government given that their operations are both informal and illegal, hence this makes the business enticing. Interview also revealed that operators of illegal refinery would also give up the flexibility and ease of deciding when to embark on their operations. Most illegal refining activities are carried out at night which is very convenient for the operators. These sacrifices would have to be made in a bid to save the environment vis a viz the climate (ibid).

6.8. Mitigation Costs

Respondents identified a shift of pollution from illegal refining to an increase in pollution in the transportation sector. The reason is that there would be an increased availability of crude products such as diesel, fuel, kerosene etc. thereby encouraging purchase of more personal vehicles, this will not only increase traffic congestion, but would also increase the tendencies for road accidents in the region. Also, unless there is a stable supply of electricity, there would likely be an increase in household emissions due to increase in the purchase of carbon dependent power generating-sets, due to the abundant supply of fuel from the operations of modular refinery. The study also found that just like conventional oil companies that offer lucrative wages, modular refineries may offer high wages as well. The implication would be that some members of the local community may likely abandon their traditional productive

ventures which are vastly agricultural based, to gain employment in modular refinery. This may further contribute to food insecurity, hunger, malnutrition and mono-economy.

6.9. Mitigation Baseline

The interview revealed that the prospect of averting impending climate change effects would be more catastrophic, and severe if nothing is done to address the deteriorating situation. According to Krupnick, Burtraw, & Markandya (2000, p.12) “The assumption of the emission that would occur in the absence of a mitigation policy is referred to as baseline.” The study found that the socio-economic and political situation in the region would most likely worsen in the future in the absence of any meaningful and sustainable mitigation policies. Hence, the likelihood of increased and unpredictable variation in rainfall patterns, flooding, erosion, reduction of agricultural yields, hunger, increased communal conflict over left over lands, illegal refining, oil spills, air pollution, and other forms of environmental and socio-economic issues.

6.10. Conclusion

The findings and discussion from this chapter suggests that most members of the local community in the region are optimistic on mitigation of climate change via modular refinery; they perceive mitigation as having enormous benefits than costs. While few members referred to as pessimist in this study, share the sentiments that mitigation has more costs than benefits. Therefore, the study foresees successful future mitigation due to anticipated high participation and cooperation by members of the community.

CHAPTER SEVEN

7.0. Conclusion

This study examined the perception of the local communities on mitigation of climate change via modular refinery, as well as the perceived socio-economic ancillary costs and benefits of mitigation. The literature review shows that agriculture is the major occupation of the local community, however, since oil activities began in the region, the environment has been severely degraded with little efforts by the government to salvage the situation, hence the emergence of illegal refining as a survival option. The latter contributes to climate change due to the toxic gases emitted from its operations.

The findings and analysis has shown that the effect of modular refinery as a mitigation tool is multifaceted as noted in the ancillary costs and benefit theory of climate change mitigation. Responses from the interview were grouped into two categories based on respondents' perception on mitigation. The optimist shows that mitigation has enormous ancillary benefits such as the reduction of pollution related diseases and deaths, increased employment, reduced communal conflicts etc. The pessimists expressed doubt on the intent of mitigation based on past experiences where government reneged on social contracts. Hence, indicating a trust gap and believe that mitigation would benefit the local communities in terms of employment creation etc. The pessimists feel that mitigation would increase the supply and availability of petroleum products and would as well increase dependency on these products thereby shifting pollution from illegal refining to the transport sector; these could be considered as ancillary costs. In other words, modular refinery in the long term would increase fuel availability, accessibility and dependence and increase emission from the transport sector and household electricity generation. The study also reveals that the pessimist benefits more from the present illegal refining activities, hence their preference for baseline.

Information dissemination is vital in bridging the trust gap, to ensure massive participation by the local community without which mitigation may not be successful. Information dissemination is also paramount in making the public understand that some of the estimated and anticipated benefits may accrue in the long term rather than short term, least the people may become apathetic and disenchanted with the whole process.

Both groups of respondents feel that the proposed introduction of modular refinery in the region signals an awakening of government to its long-neglected responsibility in the region. This perception reinforces the claim that mitigation of climate change is still not prioritized by policy makers in most developing countries as observed by (Sims, Goresvski, & Anenberg, 2015). For mitigation to succeed, both groups would make some sacrifices by giving up any form of benefits derived directly or indirectly from illegal refining activities, this include but not limited to convenience, quick and untaxed monetary returns.

7.1. Recommendations

This study recommends that the findings and analysis, should serve as a guide for mitigating climate change via modular refinery. It is pertinent to note that mitigation via modular refinery is a good first step; it would help in bringing tranquility in the region as well as aid in the transition from carbon energy to renewable forms of energy. Hence, the government, and all parties involved while implementing mitigation via modular refinery, must also start planning well in advance on transitioning to cleaner energy which are proven to be more sustainable, efficient, cost effective and beneficial in the long-term. Information dissemination on mitigation should be taken more seriously to create the needed influence, because “behavior, lifestyle and culture have a considerable influence on energy use and associated emissions” (IPCC 2014, p.20).

Setting up modular refinery should be ethical in other words; it should not worsen the situation in the region. To achieve this therefore, there should be proper regulation of the operations of modular refineries to ensure that communities in the Niger Delta benefits in employment at these refineries. Furthermore, routine maintenance of oil facilities should be taken seriously to avoid unnecessary emission of toxic gases. Licenses for establishing modular refineries should be extended to the people of the region; it should not be limited to few political classes, as is the case with the ownership of oil blocks domiciled in the region.

Mitigation policy should establish a contributory fund where all staff of modular refineries would contribute part of their earnings just like the contributory pension fund; this would be used in purchasing clean and renewable household technologies. The rationale for this is to ensure gradual transition from carbon energy. The fund could be referred to as ‘Saving for Clean Future’ (SCF). Members of the local community on their own part, should be disposed

to cooperate and participate actively in the mitigation process, this would obviously require some level of sacrifices (opportunity costs).

To maximize the benefits of mitigation, the government and the MOCs should implement the long overdue environmental clean-up of Ogoniland, and other severely affected areas in region, it should also work towards ending gas flaring.

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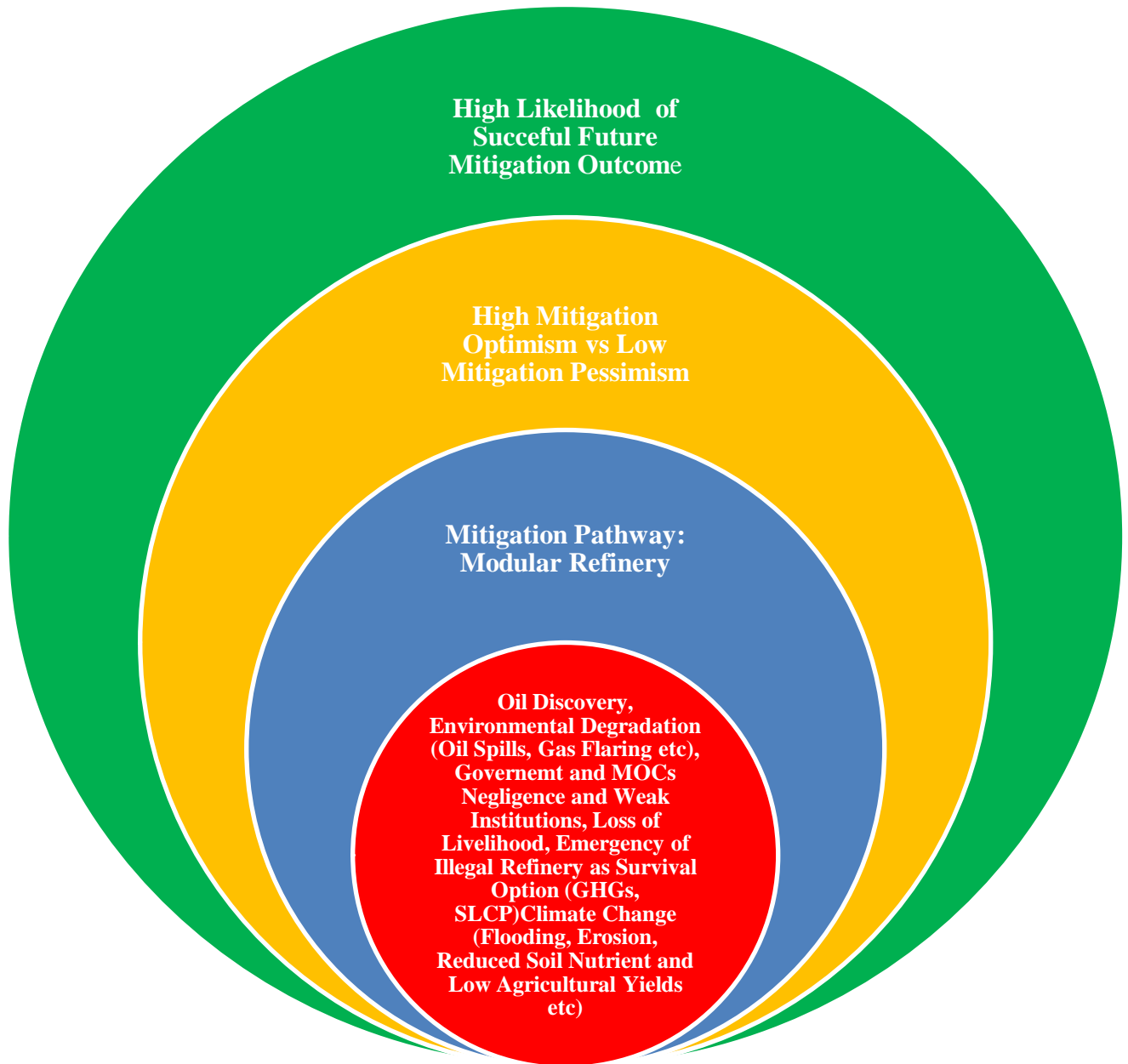
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Appendix 1



Dynamics of Climate Change Mitigation via Modular Refinery in the Niger Delta (Ejike, 2018)

Red = Environmental challenges, causes and effect. Blue = Suitability and Reliability of Mitigation tool based on context. Yellow= High optimism of mitigation benefits, and disposition to participate in mitigation process (Behavioral Change). Green= High likelihood of successful future mitigation outcome.

Appendix 2

Interview Guide

RQ1. How does the local community in Port Harcourt perceive modular refinery as a tool for mitigating climate change?

- Are you in support or opposed to the proposed introduction of modular refinery in the Niger Delta and why?
- What are the possible benefits or costs of modular refinery on the environment?
- Would modular refinery positively or negatively affect climate change and in what ways?

RQ2. What are the perceived socio-economic costs and benefits of climate change mitigation via modular refinery?

- Do you think that mitigation of climate change via modular refinery would have a positive or negative socio-economic impact and in what ways?



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