

A Framework for Investigating Marine Environmental Pollution and Implementation of Control and Preventive Measures for Oil Spillages in Akwa Ibom State

Antai, Emmanuel E.^{1*}, Daniel, Tamunodukobipi T.², Igboanusi Chinemerem³

1. Department of Marine Engineering and Naval Architecture, Akwa Ibom State University, Ikot Akpaden, Nigeria

2. Department of Marine Engineering, Rivers State University, Port Harcourt, Nigeria

3. Department of Transport Management Technology Federal University of Technology, Owerri, Nigeria

-----ABSTRACT-----

This paper presents a framework for implementation of control and preventive measures for marine environmental pollution from oil and gas activities in Niger Delta region, with Akwa Ibom State as a case study. Unsustainable oil exploration activities have rendered the Niger Delta region one of the most severely petroleum damaged ecosystems, characterized by massive ecotoxicology, environmental degradation, loss of biodiversity and destruction of marine resources. Both qualitative and quantitative techniques are implemented for data gathering, analysis and interpretation. A total of 150 respondents participated, with 81 male and 69 females, aged between 16 and 60 years, from four major villages: Upenekang; Mkpanak; Iwoachang; and Inua Eyet Ikot. Research tools utilized include: questionnaires, focus-group discussion (FGD), personal observations and interviews. The results indicate that the communities have been impacted negatively by oil and gas activities ranging from polluted air, land and water. To combat the menace of marine pollution, it is proposed that company's operating license should be updated and reviewed to reflect environmental safety compliance, implement proper remediation of impacted ecosystem, emphasize proper waste treatment and/or disposal, ensuring good surveillance and preventive maintenance culture, periodic evaluation of pipeline vulnerability assessment for structural integrity, etc. Implementing these recommendations can significantly mitigate environmental pollution.

KEYWORDS: - Oil and Gas activities, Marine Environmental Pollution, Case Study

Date of Submission: 27-03-2021

Date of Acceptance: 10-04-2021

I. Introduction

Crude oil has been the mainstay of Nigeria's economy since its commercial production in 1958. There have been unsustainable processes and obsolete equipment and laws involved in harnessing this natural resource (Ingelson, & Nwapi, 2014). This has wrecked great havoc to the Niger Delta environment which is very sensitive and ecologically endowed. The Niger Delta's people have suffered environmental racism and marginalization in the hands of the operating companies and the Nigerian State since the inception of oil and gas developments (Emoyan, 2008). The most adverse environmental impacts usually occur during the exploration and production stage (Boele et al., 2001). Offshore activities such as platform emplacement, dredging, pipe-laying, and construction of support facilities cause physical disturbances and produce various emissions and discharges of pollutants into the sea. Pollution hazards also come from disposal of sewage and garbage from offshore platforms, flaring of natural gas, and discharges of produced formation waters into the sea (Ingelson, & Nwapi, 2014; Emoyan, 2008). However, the greatest pollution hazard comes from offshore drilling. Drilling operations are always associated with discharges of drilling fluids, muds and drill cuttings. Discharges of various substances into the sea pose a significant ecological threat because they may have chronic and deteriorating effects on the marine environment.

Any process that introduces harmful or poisonous substances into the natural environment can be considered as a process of environment pollution. In a study on marine environmental pollution, Cranford et al., (1999) agree that marine pollution is the introduction of toxic materials such as plastic, oil, chemicals, agricultural and industrial waste into the ocean waters. Pollution can originate from land or from the sea. If it comes from land pollution can be classed as point source or nonpoint source pollution. Point source pollution refers to pollution from a single, identifiable, and localized source such as directly discharging sewage and industrial waste into the ocean. Nonpoint source pollution, on the other hand, refers to pollution from ill-defined and diffuse sources for example agricultural runoff and windblown debris (IMO, 1991 & IMO, 2004). The marine environment becomes

polluted and contaminated through various sources and forms, and one of the primary causes of marine pollution is oil spillage (IMO, 1977).

Many drains lead directly to rivers, streams or lakes, and if oil is allowed to enter a drain it can have the same effect as pouring it directly into a watercourse. In this respect, just 1 liter of oil can contaminate 1 million liters of water. For that reason, oil spillage has consistently been among the top three pollutants considered over the past years. Apart from oil spillage other leading causes of marine pollution include sewage, toxic chemicals from industries, nuclear waste, thermal pollution, and plastics (IMO, 1991). Air pollution also carries pesticides from farms and dust into the marine waters. Air and land pollution are major contributor to the growing marine pollution that is not only hampering the aquatic ecology but also affecting the life on land. Apart from these, factors like land runoff, direct discharge, atmospheric pollution, pollution caused by ships, and deep-sea mining of natural resources contribute heavily. To protect marine animals and plants, it is necessary to prevent these pollutants from entering the oceans (Holland et al., 2013).

The activities that come with the oil exploration and exploitation cause alterations to the environment and have significant negative effects, in that the oil forms a layer on the water preventing oxygen circulation (Cranford et al., 1998). Cranford et al. (1999) suggest that oil pollution can have a devastating effect on the water environment as it spreads over the surface in a thin layer that stops oxygen getting to the plants and animals that live in the water. Oil exploration and exploitation activities have been on-going for several decades with disastrous impacts on the environment and this have adversely affected people inhabiting oil producing communities. Oil and natural gas do not produce the same kind of pollutants, and some of these pollutants can be more toxic than others. Natural environments and human health can be negatively affected by pollutants released during energy production and use depending on the level of chemicals or pollutants released. Oil spillage is one of the contentious issues confronting the government, the oil industry and the host communities.

All stages of oil exploitation impact negatively on the environment and the greatest single intractable environmental problem caused by crude oil exploration in the Niger Delta region is oil spillage. The extent of damage caused by oil and gas pollution from the petroleum industry to the environment of host communities around their area of operation is ascertained in this study. How this damage has influenced the people culturally and psychologically are discussed. The significance of this study is such that the methodology and result presented in this framework will contribute to developing the knowledge of existing literature on marine environment pollution. This paper focuses on the control and preventive measures for oil and gas pollution in the marine environment considering the case study location in Ibeno LGA, Akwa Ibom State.

It is observed that the environmental pollution most common in the case study area include air and water pollution, which can occur at any stage of oil and gas production or use. The framework when implemented is capable of creating the necessary awareness by enlightening stakeholders in the maritime, oil and gas industry about the control and prevention measures of marine pollution from oil and gas activities in Nigeria. This can serve as a reference material for further research for stakeholders and policy makers who may be interested in this area of research. In Section 2, of this paper, a review of relevant literature is presented and Section 3 presents the methodology used in this study. In Section 4, the results and discussion are presented. Finally, concluding remarks and recommendations for future work are presented in Section 5.

II. Literature Review

2.1 Environment Pollution in Niger Delta

The Niger Delta comprises 70,000 square kilometers (27,000 square miles) of wetlands formed primarily by sediment deposition. It is home to more than 20 million people and 40 different ethnic groups. The Delta's ecosystem contains one of the highest concentrations of biodiversity on the planet. The environment can be broken down into four ecological regions: coastal barrier islands, mangrove swamp forests, freshwater swamps, and lowland rainforests. The ecosystem is incredibly well-end wed, supporting an abundant flora and fauna, arable terrain that can sustain a wide variety of crops, economic trees, and more species of freshwater fish than any ecosystem in West Africa. The possible environmental impacts of petroleum exploration activities have been discussed by several authors in Boudreau et al. (1999). Marine pollution is described as "the introduction by means directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of Amenities".

2.2 Sources of Marine Environment Pollution

There are three main types of inputs of pollution into the ocean and these may include: direct discharge of waste water into the oceans, runoff into the waters due to rain, and contaminants that are released from the atmosphere. Runoff from agriculture, urban dwellings, and construction carry soil and particles laden with carbon, nitrogen, phosphorus, and other minerals to rivers and subsequently to the ocean. Boufadel et al. (2010)

opined that the nutrient-rich water causes algal blooms in coastal areas which have the potential to create hypoxic conditions by using up all available oxygen. Studies modelling the potential effects of petroleum explorations and drillings have acknowledged inland mining as a source of marine pollution, and windblown dust and debris: such as plastic bags, blown seaward from landfills and other areas as pollutants of the oceans (Cranford et al., 2003). Some minerals, such as copper, discharge during land water wash up into the ocean produce harmful effects which can be detected in the history of life and development of coral polyps (Cranford et al., 1999).

The international convention on civil liability for pollution damage emphasizes the fact that healthy ocean ecosystems are also important for mitigating the effects of climate change (IMO, 2011). The oceans are normally a natural carbon sink, which absorb carbon dioxide from the atmosphere. Increase in ocean temperature and level of carbon dioxide in the atmosphere are caused by climate change. As a result of rising levels of carbon dioxide in the water, the ocean water becomes acidified (Azetsu-Scott et al., 2007). This, in turn changes the aquatic ecosystems and causing the redistribution of aquatic lives (Boudreau et al., 1999). The removal of parts from the seabed will cause turbulences to the benthic layer or habitat of benthic organisms. As a consequence, causing permanent disturbances that would increase toxicity of the water column and sediment plumes from tailings (Azetsu-Scott et al., 2007). The impacts can be observed on the sustainability of fisheries and the livelihoods of the communities that depend on them.

2.3. Ships as a Source of Marine Pollution

The different ways of polluting waterways and oceans by ships can include disposal of garbage, sewage, invasive species, noise and oil spills (IMO, 2004). In many instances, vessels intentionally discharge illegal wastes, for instance garbage and sewage, which have a negative impact on the marine environment, particularly plastic materials that remain many years in the ocean without the disintegration and will affect the food chains for marine organisms (ITOPF, 2013). The water from ballast tanks can spread dangerous algae, introduce invasive species which can take over the habitat once they are fully established, facilitate the spread of new diseases, introduce new genetic material, alter underwater seascapes and jeopardize the ability of native species to obtain food (Boufadel et al., 2010). Ships also create noise pollution that disturbs natural wildlife, their habitats and behavioral patterns. Furthermore, the oil spills from ships can have devastating effects. While being toxic to marine life, polycyclic aromatic hydrocarbons (PAHs), the components in crude oil, are very difficult to clean up in different geographic conditions, and the effects last for years in the sediment and marine environment (Tinker et al., 2005).

2.4. Oil Spillage as a Source of Marine Environment Pollution

Reports on tanker spill statistics describe marine oil spills as the release of liquid petroleum hydrocarbons into the marine environment due to anthropogenic activities (ITOPF, 2013). Marine oil spills include the release of crude oil from tanker ships, directly from accidents and indirect from ship operations, offshore platforms, drilling rigs and wells, as well as spills of refined petroleum products, such as gasoline, diesel and their by-products and heavier fuels such as bunker fuel used by large ships, or the spill of any oily white substance refuse or waste oil (Armsworthy et al., 2005). The international convention on civil liability for bunker oil pollution describe the characteristic properties of oil spills into the marine environment (IMO, 2004).. It is observed that when oil is spilled into sea water, it undergoes a number of physical and chemical changes. The time involved in this process depends on the initial physical and chemical characteristics of the oil and the natural weathering processes. Some of the spilled oil disappears from the sea water surface. Nevertheless, some of the oil may remain, although they may not be easily located as to trace the fate of the oil spilled in the marine environment.

ITOPF (2013) provides historical details for major oil spills, asserting that “spills are generally categorized by size, <7 tons, 7–700 tons and >700 tons (<50 bbl., 50–5,000 bbl., >5,000 bbl.)”. Large Oil spills often result from collisions, groundings, structural damage, fires or explosions. These account for most of the oil lost to the environment, including those which got burnt or remained in sunken vessels. Information is held on “nearly 10,000 incidents shows that the actual amount spilt is also recorded (ITOPF, 2013). The vast majority of which (81%) fall into the smallest category i.e., <7 tons. ITOPF (2013) acknowledges that there is a drastic decrease in number of incidences of large oil spills. The Study suggests that “the number of large spills (>700 tons) has decreased significantly through the last 43 years, during which registers have been kept. A decline can be observed with medium sized spills (7-700 tons). The average number of major spills for the previous decade (2000-2009) is just over three, approximately one eighth of the average for the years in the 1970s. Looking at this downward trend from another perspective, 55% of the large spills noted happened in the 1970s, and this percentage has reduced each decade to 7% in the 2000s (ITOPF, 2013).

2.5. Oil and Gas Activities in Akwa Ibom State

In Ibena Local Government Area (LGA), and its environs in Akwa Ibom State, crude oil exploration started in the late 1960's, and was started by Mobil Oil (Frynas, 1999). Mobil is the major operator in this area. The Qua Iboe Terminal (QIT), (its operational base) is located and operated by Exxon Mobil. Ibena surrounding is generally dominated by oil and gas operations, some of which include exploration activities and seismic work. Long before the exploration and production of crude oil in the Ibena area, QIT was totally a virgin territory (forest) and was dominated by animals like elephants. Since the discovery of oil in Nigeria in the 1950s, the country has been suffering the negative environmental consequences of oil development (IPEIA, 2007). The growth of the country's oil and gas industry, combined with a population explosion and a lack of environmental regulations have led to substantial damage to Nigeria's environment (IPEIA, 2009). This is particularly true in the Niger Delta region, the center of the country's oil and gas industry, of which Ibena LGA is a part (Ingelsson, & Nwapi, 2014).

Oil spillages from oil and gas activities causing marine environmental pollution have occurred primarily in the main oil producing communities such as Ogoni in Rivers State and Ibena in Akwa Ibom State (Ingelsson, & Nwapi, 2014). These are riverine areas of the Niger delta, in which the Ibena LGA forms a part. Most of the inhabitants of Ibena LGA are involved in fishing activities. The economic benefit of crude oil exploration and production in Akwa Ibom State, both onshore and offshore, have been so overwhelming, until recently, when the adverse ecological devastation, socio-economic depreciations and environmental deterioration in Ibena community became very obvious (IPEIA, 2007; IPEIA, 2009). Ingelsson and Nwapi (2014) argue that in spite of the immense wealth accruing from crude oil, extensive damages of farmlands, forest, streams and creeks and the persistent threat to health of the inhabitants of this region have been ignored.

2.6. Causes of Oil spillage in Akwa Ibom State

Oil spills are discharges of oil (crude or refined) into the environment which normally occurs as a result of an accident caused by the malfunctioning of equipment or through human error. Generally, oil spillage occurs during crude oil production, refining, marketing and transportation of crude and refined products. Badejo and Nwilo (2004) reveal that in Nigeria, fifty percent (50%) of oil spills is due to corrosion, twenty-eight percent (28%) to sabotage and twenty-one percent (21%) to oil production operations. One percent (1%) of oil spills is due to engineering drills' inability to effectively control oil wells, failure of machines, and inadequate care during loading and unloading oil vessels. Sabotage is a major cause of oil spillage in the country, and particularly in Ibena LGA of Akwa Ibom State. Sabotage is performed primarily through what is known as "bunkering", whereby the saboteur taps a pipeline, and in the process of extraction sometimes the pipeline is damaged. It is observed that some of the citizens resident in the local community in collaboration with people from other countries engage in illegal oil bunkering. In their effort to steal oil from oil pipelines they damage and destroy the pipelines. They conclude that illegal siphoning of fuel products as a result of the thriving black market increased the number of oil pipeline explosions. Oil extracted in this manner is often sold for cash compensation. Nigeria's crude oil has been stolen at a phenomenal rate, funneling nearly 300,000 barrels per day from Nigeria's oil and selling it illegally on the international market (Ingelsson, & Nwapi, 2014).

2.7. Environmental Impact

2.7.1. Impact of Oil Spillage on Marine Environment

The impact of oil spill on the marine environment have been experienced in different ways around the world. For example, the Impact of the Exxon Valdez oil spill that occurred in Alaska, in 1989, was caused by humans, and resulted in the spilling of about 40 million liters of oil into the sea. Pandey, et al. (2014). claim that these oils spills lead to contamination of the water resources by pathogenic bacteria and death of fish and other marine animals, while other effects include the destruction of the mangrove habitat and other sources of ecological balance in the area of spill. Beyond the impact of environmental contamination, oil spill can affect the communities socially and agriculturally especially when the population are recognized as fishermen and farmers as their rivers and farm lands can be rendered unusable by oil. The effect of oil pollution on marine ecology is rather complex and diverse. Almost every form of aquatic life is affected on a large scale. Oil pollution has caused the death of organisms by poisoning through exposure to soluble toxic component of oil.

2.7.2. Water Contamination Resulting from Oil Spills

Oil spills are a common occurrence, estimates show that about 7,000 spills occurred between 1970 and 2002, and between 9 and 13 million barrels (1,400,000 and 2,100,000 m³) have been spilled since oil drilling started in 1958 (Boele et al., 2001). It is observed that Oil Spills which occur during petroleum operations have caused a slow poisoning of the waters and the destruction of vegetation and agricultural land. Oil spills have a major impact on the ecosystem. Large tracts of mangrove forests have been destroyed and sources of drinking water have frequently been contaminated. They are especially susceptible to oil spills because the oil is stored in the soil and re-released annually with each inundation. oil Spills destroys crops and aquacultures through

contamination of groundwater and soils. A sheen of oil is visible in many localized bodies of water. If the drinking water is contaminated, even if no immediate health effects are apparent, the numerous hydrocarbons and other chemicals present in oil represent a carcinogenic risk. Offshore spills, which are usually much greater in scale, contaminate coastal environments and cause a decline in local fishing production. The oil industry and Nigeria government should show more concern and effective effort to control environmental problems associated with the industry.

2.7.3. Natural Gas Flaring

This represents another environmental issue in the Niger Delta. It is observed that natural gas associated with oil extraction is wasted via flaring more in Nigeria than any other country. Gas is flared to increase crude production because the cost of separating commercially viable associated gas from oil is high. Most oil companies operating in Nigeria prefer to extract gas from deposits where it is found in isolation as non-associated gas. Gas flaring in Nigeria releases large amounts of methane, which has a very high global warming potential. The methane is accompanied by carbon dioxide. Gas flaring contributes to climate change hence it is discouraged by the international community. Flares are known to coat the land and communities in the area with soot, and damage adjacent vegetation. Gas flares are often within close proximity to local communities and the lack of adequate fencing or protection possess a source of hazard for villagers who may risk nearing the heat of the flare in order to carry out their daily activities. Gas flares release a variety of potentially poisonous chemicals such as nitrogen dioxides; sulfur dioxide; volatile organic compounds like benzene, toluene, xylene, and hydrogen sulfide; as well as carcinogens like benzopyrene and dioxins. The Nigerian government, the oil corporations and the international community seem to agree that gas flaring need to be curtailed, efforts to do so have been slow and largely ineffective. The reason is Nigerian regulations are weak and rarely enforced allowing oil companies, in essence, to self-regulate

III. Research Methodology

The research methodology presents the strategy and relevant information required to develop the framework for implementation of control and preventive measures for marine environmental pollution resulting from oil and gas operation activities in Akwa Ibom State. As discussed in the preceding section, when harmful and toxic organic compounds are introduced into the natural environment during oil exploration and exploitation activities, this changes the geo-chemical composition of the soil, river and other components of the environment. This in turn affects agriculture and leads to a drastic decline in output in both farming and fishing activities. The research strategy adopted involves a survey study-design applied to collect data that would assist the researchers to investigate and assess the control and preventive measures of marine environmental pollution.

3.1. Research Design

This section describes the research plan, structure and strategy applied to investigate the problem with marine environmental pollution, so as to provide the much-needed answers to research questions or to control variance. The nature of this study detects the choice of research methodologies that is applied. Kerlinger (1970) has suggested several research designs that could be utilized in research investigations. Others like Wimmer and Dominick (2003) emphasize that research designs can contain descriptive survey design, historical case studies and observational and participatory research designs. As presented in this paper, the descriptive survey design and the case study design approach are employed in the conduct of this research. The descriptive survey design is chosen because of its significance to help describe record, analyze and interpret the conclusions that exist in the study.

The case study design approach is also appropriate for this study because it allows the researchers to focus on a specific example or state of affairs and to identify, or attempt to identify, the various interactive processes at work (Bell,1987). This research study employs a combination of both quantitative and qualitative research methods. In this case, the quantitative research technique using questionnaire is adopted because the use of numbers allows greater precision in reporting results (Kerlinger, 1970; Bell, 1987). The qualitative technique helps to increase the researchers' depth of understanding of the phenomenon under investigation (Holstein & Gubrium, 1995). Qualitative information that is utilized in this research involves interviews and retrospective case studies. The significance of this method is such that it allows the researchers to view behavior in a natural setting without the artificiality that sometimes surrounds experimental or survey research (Wimmer & Dominick, 2003)

3.2. Population of Study and Sampling Procedures

In this study, the population comprised of a total of one hundred and fifty (150) respondents, both male and female members residing in the community. The method of simple random sampling is adopted and used in selecting the sample from the population. The reason is that the case study area is so large that simple random sampling becomes the most effective approach to arrive at a conclusion under the circumstance. The selected adult male and female members of the community are from the selected villages (Upenekang, Mkpanak,

Iwoachang and Inua Eyet Ikot) in Ibeno LGA. As long as the individuals reside in the case study community, no exclusion or inclusion criteria are applied.

The description of Sample is such that the sample target consists of 150 respondents, targeting in retrospect 81 male and 69 females, aged between 16 and 60 years. Demographic data such as age, gender, marital status, educational qualifications, occupation and household size are applied. The respondents include indigenes and non-indigenes of Ibeno who are resident or have domiciled there for a long period of time. The importance of sampling in its renowned function of statistical proportion of a given population that represents the whole cannot be over emphasized. This helps to eliminate bias and as much as possible reflect on the true situation within the community, rather than confine oneself to a selected idea of a chosen few (Wimmer & Dominick, 2003).

3.3. Data Collection Techniques

3.3.1. Structured Questionnaire

The data collection techniques used in this study relied heavily on a structured questionnaire. This is considered an appropriate instrument for data collection in carrying out this study. The reason is that studies on qualitative research methods show that structured questionnaires could be utilized as face-to-face techniques as level of literacy is low (Holstein & Gubrium, 1995). In this respect, the questionnaire is structured in simple and clear terms with both direct and logical questions to meet the standard of all classes of people interviewed (Holstein & Gubrium, 1995; Wimmer & Dominick, 2003). The questionnaire is structured to contain two sections, A and B respectively. The information Section A collates is personal data. This includes information on gender, age, marital status, educational level and occupation. The information contained in Section B consists of 10 items which are meant to collate information from the respondents on the impact of marine environmental pollution from oil and gas activities in the area with special attention to oil spillage. In this case, the respondents are required to tick (✓) in the column that best corresponds with their line of thought. A four-response pattern is adopted: (i). Strongly Agree (ii). Agree (iii). Disagree (iv). Strongly Disagree.

3.3.2. Interview

In the process of acquiring the relevant information needed by the researchers for this study personal interviews are also conducted. It is observed that some of the respondents are somewhat deficient in English which is the main language the researchers used for communication. For that reason, a research assistant is employed, for language translation and to aid communication. The techniques of the interview are semi-structured with the aim of extracting detailed and important information from the subjects of the study. Nachmias and Nachmias (1992) admit that the main reason for using this technique is that “An interviewer can collect supplementary information about respondents. This may include background information about personal characteristics and their environment that can aid the researcher in the interpretation of the data”

3.3.3. Observation as a Tool

Observation can in itself provide a very useful tool for data collection in a research study. This is particularly true in connection with areas physically affected as in this case of marine environmental pollution resulting from the oil and gas exploration and exploitation activities in the host communities. Observation as a tool is very useful in the course of this research, as it is used to compliment data collected from other data sources. Observation also helps to identify important variables and provides useful preliminary information. Perhaps the most noteworthy advantage of this technique, is that the study takes place in the natural setting of the activity being observed. Thus, it can provide data rich in details and refinement. Observation enables the researchers to provide access to groups that would otherwise be difficult to examine.

3.3.4. Documentation

The documentation processes are very useful to gather information that will help the researchers to gain more knowledge and understanding of the research problem as well as to make appropriate interpretation of the research findings. For the description and explanation of the research study the process of documentation is used in acquiring detailed information. The documents comprised of the use of internet information script, magazine articles, as well as various newspapers and other important documentations. All these sources are very useful to the researchers, as the information gathered is utilized and helped the researchers to gain the desire knowledge.

3.4. Data Collection and Data Analysis Procedure

The four villages selected for the study are visited and permission to carry out the study in the selected villages is obtained from the authorities such as the village heads and chief in charge and this process is well documented. This action is necessary to ensure that successful work on data collection can be carried out in the area. The data collection procedure begins with introducing the purpose of the study to the correspondence, as well as assuring them of their data confidentiality. This is by rephrasing that the information they will give out

would be kept confidential and used only for the purpose of this study. A standardized question format is utilized in interviewing each subject. Thereafter administering the questionnaires, the filled-out questionnaires are retrieved and comments noted are written on the spaces provided in the questionnaire.

For simplicity and clarity, the data analysis procedure involved subjecting the data collected to a process of descriptive analysis. Therefore, using simple statistical analysis as well as using pie charts and graphs, each characteristic found in the material is analyzed. Responses collated from the items on the questionnaire form the basis for data coding. In addition, the qualitative data collected from the personal interview are transcribed and translated into subsections. The process of inductive reasoning as well as content analysis is then utilized to ascertain the extent of impact (Holstein & Gubrium, 1995; Wimmer & Dominick, 2003). Finally, information obtained from the observational procedure is also used to complement that which was obtained from both quantitative and qualitative data.

IV. Results and Discussion

This section presents the results of the qualitative and quantitative data analyses and interpretation of the statistical data collected from the case study area. Results of procedures such as Focus Group Discussion (FGD), Observation, and Interview used in gathering data by the researchers during the course of research in the study area are presented and discussed.

4.1. Results of Qualitative

4.1.1. Focus Group Discussion (FGD)

Focus Groups (FG) offer a platform for interactive discussion: hence, they are used in this study to collect information. In this study the FGD is made up of 12 participants from each village in Ibeno. The group is selected based on strong recommendations by the people. This is particularly due to their track records, strong contributions and enormous impact with conflict resolution. The FGD are mainly conducted within a well-known and already formed group. This could be a branch of a bigger group domiciled in the case study area. The focus group interview and facilitation encourage the respondents to be more candid in their responses. Thus, ensuing in less individual pressure as well as spontaneous responses, especially when people have a definite point of view.

FGDs enable the group process to generate a wider range of information and it enhanced the respondents' views. In this respect, the FGDs are used as a tool to compliment the questionnaire used in the data collection. The FGD often starts with the necessary introduction formalities and informing the focus group members of the main aim or reasons for assembling the group. In this case the discussion is aimed at determining their general knowledge about marine environmental pollutions associated with the activities of oil and gas companies in Ibeno L.G.A. The researchers moderate the group in order to save time, enable all members of the focus group to be able to participate in the general discussion and avoid it being dominated by a single individual or a few out spoken ones.

The researchers ask the participants some vital questions for the research study. The important questions asked are: (1). What are the major hazards due to marine pollution in your community? (2). How do these hazards impact your health? (3). What are their major sources? (4) What are the likely causes? (5) How do they impact your socioeconomic life? (6) Are there any pollution preventive or control measures in place? (7) What remediation techniques are implemented to recover impacted water? (8) Are affected individuals or communities adequately compensated? etc. There is a quick agreement amongst the group that oil spillage is considered to be the major hazard in the community, amongst others (erosion, flooding, excessive heat, gas flaring and drought), and that it has impacted negatively on the members of the community. Other responses received from the focus group are the issues of marginalization and severe neglect of the inhabitants, the environment, Oil pipeline vandalization by the community members during conflict with the federal government. Lack of good roads, pipe-borne water, and poorly equipped hospital facilities.

These discussions uncovered several issues affecting the host communities. The issues include oil spillage, which has seriously affected their livelihood for years. This is mainly in terms of the enormous impact of the oil spillage on fishing activities. The respondents stated that oil spill not cleaned up causes their fishing nets to often get stained making them unusable. The people describe their water as containing crude oil. The major sources of drinking water (river, wells and streams) have been exposed and contaminated by various oil spills.

Another issue is the intensified bitter conflicts as a result of lack of transparency and openness in the way the community chiefs related with the oil companies and government. Their responses suggested that the chiefs of the community do not offer to the community all the oil royalties/benefits that had been offered to them by the oil companies. In most cases, they do not bargain properly for adequate social and structural benefits. Findings from the group discussion indicated that since the coming of the oil companies, the entire community have suffered grievously. The responses suggested that specific issues such as the massive

contaminations of soil and water bodies especially those that served as drinking source, are caused by oil spillage from oil and gas activities in the area.

4.1.2. Results on Observation

In this study Observation provided useful preliminary information which helped to identify some important variables. The most noteworthy advantage of observation as a technique, is that the study takes place in the natural setting of the activity being observed. Based on observation in the case study community (Ibeno), it is noted that the community consists of twenty-three clans divided into two sub-areas by the Qua Iboe River. The area across the river being made up of six (6) villages, headed by different village heads. Due to limitations of the study the observation is carried out generally in the case study community particularly in four randomly selected villages (Upenekang, Mkpanak, Iwoachang and Inua Eyet Ikot).

Based on information from subjective observation, it is obvious that the entire community has been psychologically alienated and affected by the activities of the oil companies located there. Most of the streams and rivers in the community of study have been abandoned as a result of a high rate of contamination by various oil spills in the community. Thus, the impacted streams and rivers are unusable and devoid of marine fauna and flora. The source of their livelihood, the streams and rivers, look turbid and dead. This pollution has forced the people in the community to travel long distances by canoe to neighboring villages to buy water for drinking and cooking.

The housing conditions in Ibeno LGA are very poor. The majority of the houses in this community are mud-and-thatched hut, which are commonly called 'mud houses. These houses are made up of thatch, bamboo, wood and puddle, while the roof is made up of mats from raffia palm fronds. With pipelines crossing in front of the houses, in other words, not properly dug, these houses are vulnerable to fire outbreak in the case of oil spill. This is a fact that was emphasized by some respondents during the personal interview section, where it was said that during the 1998 oil spill in Ibeno, some of the houses that were close to the site of the incident were actually burnt down and there were a lot of mortalities and morbidities.

4.1.3. Interview Results

Interviews are conducted in order to probe and gather data on the individuals' knowledge of the impact of marine environmental pollution in their community. This is with special reference to the impact of marine environmental pollution from oil and gas activities. The results include responses from personal interviews conducted in case study community. The interview sessions are conducted by the researcher with 12 representatives from the community.

The interviewees consisted of 4 women, including an elderly woman aged 71, and 8 men respectively. These interviewees were selected using a process of random sampling done by interviewing the oldest individual found in every third home in the community of study. The interviews take place in their respective houses. One of the respondents, a female teacher in the community secondary school, stated that marine environmental pollution, especially oil spill which had occurred in their community was responsible for fire outbreaks, which led to several loss of lives and other hazards. This is particularly so, because pipelines are laid in close proximity to human habitation.

Other factors identified are that the oil companies located in the community do not adhere to government environmental laws. The majority of them do not undertake the Environment Impact Assessment (EIA) as stipulated before starting their operation. Government agencies such as Oil Mineral Producing Areas Development Commission (OMPADEC), Federal Environmental Protection Agency (FEPA) and Nigerian National Petroleum Corporation (NNPC), in charge of evaluation and monitoring their activities or operations do not carry out their duties or have not done enough to make sure that these oil companies adhere to environmental laws.

4.2. Quantitative Data Analysis

The presentation and analysis of the quantitative data will be descriptive, adopting an analytical approach, using frequency count, percentages, tables and graphical approaches to illustrate and discuss the results. The first aspect of this study, Section A, deals with the demographic information of the study population. Data is collected from one hundred and fifty (150) members in the community thereby providing answers for each objective. The respondents include people residing in the case study community (Ibeno), within the four villages (Upenekang, Mapanak, Iwoachang and Inua Eyet Ikot). This includes indigene and non-indigenes domiciled over a long period of time, not minding their occupation. Table 1 shows results of the distribution of the data collected from sample administered in four major villages in Ibeno chosen for the study.

Table 1. Population Pattern with regard to Specific Town Distribution

Towns	Male	Female	Total
Upenkang	19	21	40
Mkpanak	27	17	44
Iwoachang	21	12	33
Inua Eyet Ikot	14	19	33
Total	81	69	150

Fig. 1. also shows the gender distribution frequency with the total number of 81 males and 69 females in various villages within Ibeno. The respondents include indigenes and non-indigenes of Ibeno, who have resided there for a long period of time. This result also depicts of the gender data collected from the indigenes. It shows that a total of 81 are male representing 54% of the respondents, while a total of 69 are females representing 46% of the respondents. Generally, the data collected for this study as shown in Figure 2, suggests that majority of the respondents are mature persons who could really appreciate the problems caused by oil and gas activities in their community.

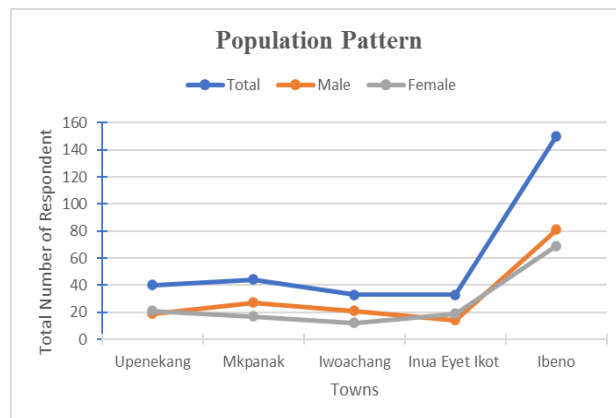


Fig. 1: Population Pattern with regard to Specific Town Distribution

In Fig. 2., the age distribution of the respondents used in the study is shown. The age range (years) on the x-axis is stated as follows: 16-25, 26-35, 36-45, 46-55, and 56 and above, with the total frequency and percentage indicated on both sides of the y-axis. Following the age distribution used it is discovered that the respondents within the age range of 16-25 are 20 representing 13.33%, 26-35 are 31 representing 20.67%, 36-45 are 30 representing 20%, 46-55 are 34 representing 22.67%, while 56 and above are 35 representing 23.33% respectively. Therefore, going by the age distribution, it is discovered that a greater number of respondents from 36 years and above, constitute a frequency of 99 or 66% of the total respondents within the oil producing community.

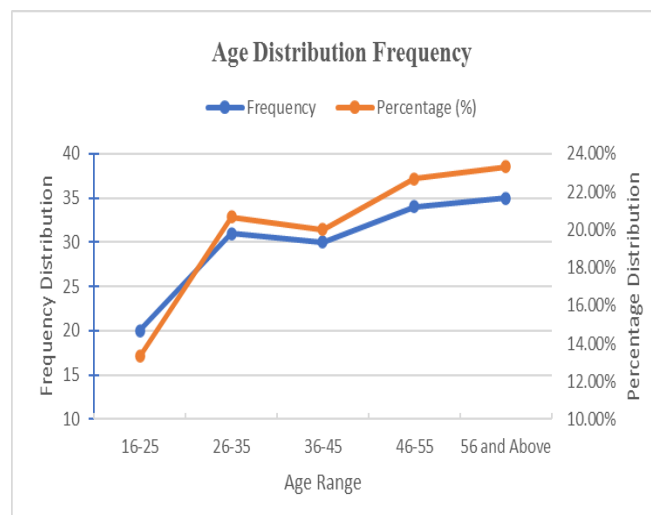


Figure 2. The Age Distribution Frequency

From the data shown in Fig. 3, it is observed that married people constitute 96 or 64% of the total respondents, while singles are 41 or 27.33%. Widows constitute 7 or 4.67% and widowers 6 or 4%, respectively. It also indicates that there are no divorced persons. In order words this implies that the majority of the respondents are married individuals in the study area because of the high frequency and percentage gained.

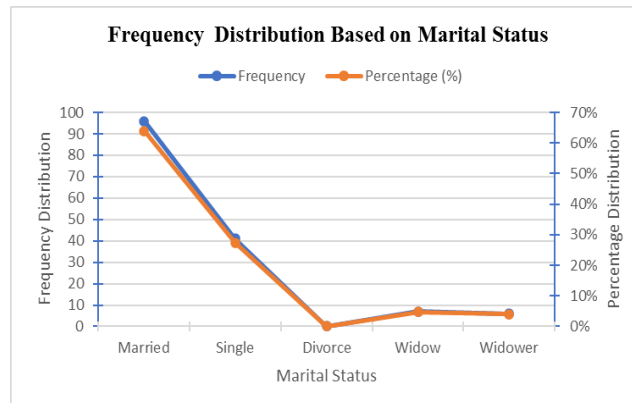


Fig.3. Frequency Distribution based on Marital Status

Fig. 4, shows that the highest number of the respondents, 43 or 28.6 percent, had no formal education, while 36 of the respondents sampled, or 24 percent of them had only primary education, and 41 or 27.33 percent of the respondent had secondary education and finally, 30 of the respondents or 20 percent of them had tertiary education, which includes either a first Degree or Higher National Diploma (HND), or even a Master’s Degree. Therefore, on the whole, about 71 percent of the respondents had some form of formal education, against 28.67 percent of the respondents who do not have any form of formal education or the other. This is an observation which tends to refute the alarming rate of illiteracy prevalent in rural communities where oil and gas explorations take place.

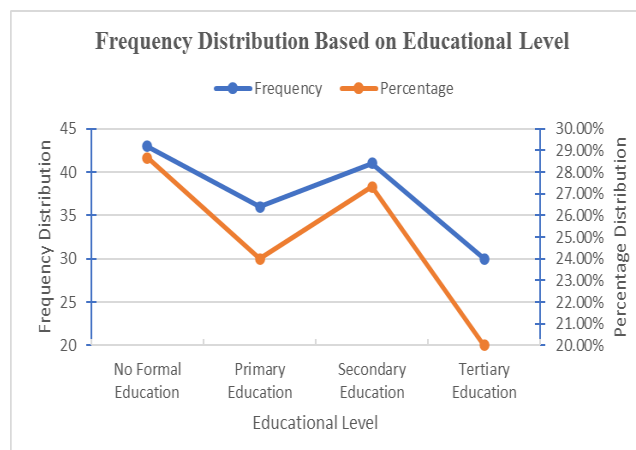


Fig. 4. Frequency Distribution Based on Educational Level

As indicated in Fig. 5., it could be seen that agricultural activities, had the greatest number of respondents of 52 or 34.66percent, and this is followed by trading and other occupational status with a number of 30 or 20.00 percent. Similarly, public sector workers and those who had retired had 12 respondents or 8.00% and 18 or 12.00 % respectively.

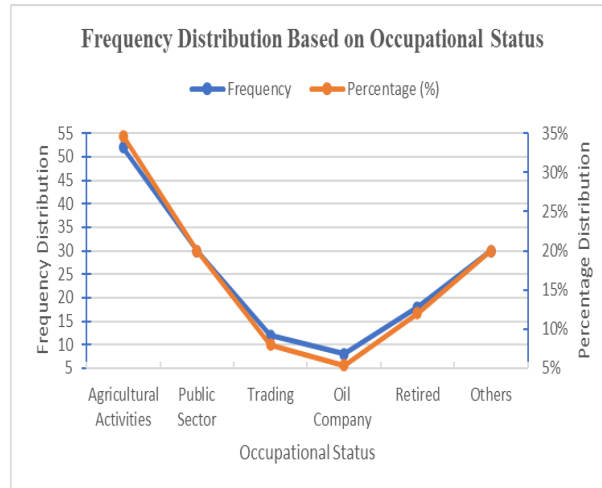


Fig. 5: Frequency Distribution Based on Occupational Status

From Fig. 6., a relatively large household size is found in the study. A household size of 9 – 12 persons per household seemed average, and about 38.67% or 58 respondents have a family size that ranged between 9 – 12 persons. About 38 or 25.33% of the respondents had a household size of 13 – 16 persons. So generally, it could be seen that Ibeno indigenes have large family sizes. Thus supporting, caring and providing for these large families could constitute a social burden, especially with the devastating impact of oil spills and the subsequent destruction of their sources of livelihood.

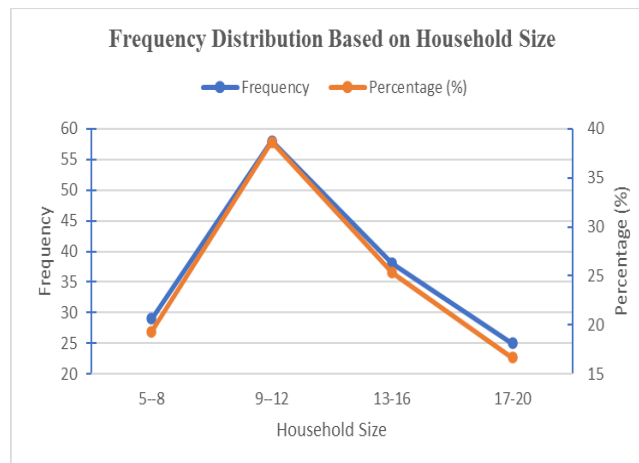


Fig. 6. Frequency Distribution Based on Household Size

From Fig. 7, it can be seen that Oil and gas activities are the major causes of environmental pollution in Ibeno L.G.A. Evidence from the data reported in the table above reveals that more than half (76.67%) of the respondents believed that the Oil and gas activities are the major cause of environmental pollution in Ibeno L.G.A. 115 (76.67%) of the respondents strongly agreed that Oil and gas activities are the major cause of environmental pollution in Ibeno L.G.A. while 25 (23.33%) agreed also, respectively. None disagreed to the fact and there was also no strongly disagreed option recorded to this fact; hence, it could be seen that Oil and gas activities are the major cause of marine environmental pollution in Ibeno L.G.A.

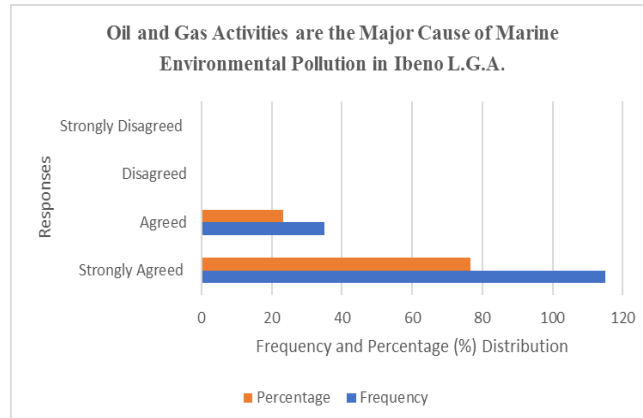


Fig. 7: Frequency and Percentage (%) Distribution of Responses chart showing oil and gas activities as the major cause of marine environmental pollution in Ibeno L.G.A.

As shown in Fig. 8, the majority of the respondents, 100 (66.6%), strongly agreed that oil spillage has been the major form of environmental pollution caused by the oil and gas related activities in the Ibeno community. 30 people agreed that oil spillage has been the major form of environmental pollution in the community. 15 people disagreed and 5 people strongly disagreed that oil spillage has been the major form of environmental pollution, but rather pointed some other forms like mining and gas flaring etc; as also causing a lot environmental pollution in the area. They also attributed some of the causes due to the poor topography of the area, which usually leads to massive erosion, thus causing pipes to burst, which should have been checked by the government or the oil companies drilling in their community.

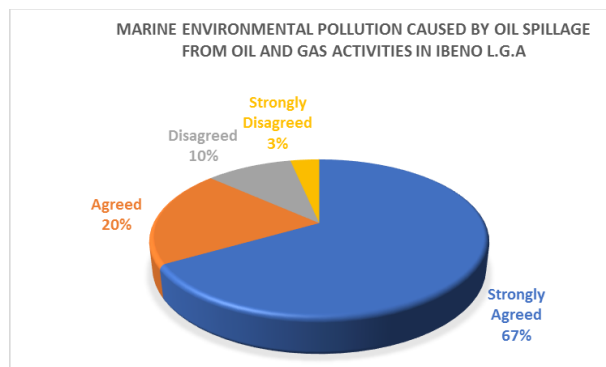


Fig. 8: Oil Spillage as a Major Source of Marine Environmental Pollution Caused by Oil and Gas Activities in Ibeno L.G.A

Fig. 9, shows results of analysis of responses gathered from the questionnaire based on response from the question “If the oil companies involved in the pollution and degradation of the marine environment have done a lot to ameliorate the problems of the people of Ibeno”? The y-axis on the left-hand side depicts the frequency of the category of response from the community member, while the right-hand side depicts the percentage of the number of responses.

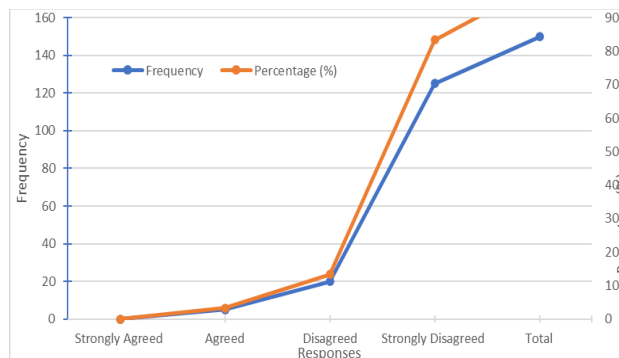


Fig. 9: The Oil Companies' Involvement in Harnessing Marine Environmental Pollution

In this respect, 125 persons representing 83.33% respondents strongly disagreed with the performance of the oil companies in ameliorating their problems, but rather, believed that the oil companies enrich themselves and the federal government at the expense of the community.

As indicated in the graph of Fig. 9, it is clear from the responses that majority of the community members are totally dissatisfied with the level of assistance from the oil companies drilling in their community. On the contrary, about 5 persons representing 3.33% of the respondents agreed that the oil companies have met their needs to an extent. This set of community members agree in terms of few infrastructure and social amenities provided, as well as bursaries granted (although not so often) to some community members. It is interesting to point out that the 3.33% that shared this viewpoint mostly fell between the age ranges of 45 – 60 (elders). However, the youths believed that this category of people were in ‘illegal’ partnership with the oil companies and the government.

4.3. Control and Preventive Measures

4.3.1. Implementation of Environmental Management Plan

Holland et al. (2013) affirm that environmental management plan is a widely accepted management tool that allows an organization to strategically and comprehensively address its environmental issues related to public, ecological health and safety. Environmental management plan is an important environmental management tool that comprises schedules, planning activities, assigning responsibilities, measures, procedures, actions, processes, awareness and implementation to mitigate or eliminate the identified effects of proposed actions on the environment. Studies on Environmental impact assessment process suggested that the requirement of environmental management plan should be included in Environmental Impact Assessment (EIA) (Ingelson, & Nwapi, 2014). This will provide a mechanism for implementing the necessary measures to manage the adverse impacts of the oil and gas projects especially in the host community. Hence, legislation for environmental management plan should be encouraged in Nigeria.

In this respect, to foster growth and sustainable development in the host communities of the oil and gas producing companies, it is essential to provide the legislations for environmental management plan. The legislations should incorporate people, policies, plans, reviews, and procedures used to manage environmental issues caused by the oil and gas activities in host communities. This will help reduce to minimum the negative effects, devastation and degradation of the marine environment especially pollution caused by oil spillage in the host community of the oil and gas producing company.

In order for the environmental regulators in the oil and gas sector in Nigeria to reduce impacts on the environment, foster compliance, increase public participation in environmental management, Holland et al. (2013) proposed that the legislation could take the form of an “Executive Order”. This will make it mandatory to implement environmental management plans within the agency or oil company, or at all appropriate organizational levels and cover all environmental activities and programs. Moreover, in order to reduce operating costs and implement environmental programs, adequate environmental management plan and mechanisms should be legislated and adopted in order to achieve an increased environmental protection from oil and gas impacting activities.

4.3.2. Implementation of Environmental Mitigation Plan

In implementing EIA regulations there is the requirement for identification and description of the mitigation measures. Hence, in applying EIA processes to projects with expected significant effects on the environment, one of the basic aims is to identify the impacts and put in place measures and plans to mitigate or totally eliminate these and highlight any positive impacts. Ingelson and Nwapi (1999) insisted that after the approval of an EIA have been granted, it is necessary to monitor whether the proposed mitigation measures are being implemented and, if they are in place, and how they are working. It is significant to note that proposed mitigation plans often times facilitate the approval of EIA for projects that have adverse effects. For that reason, studies on impact mitigation in environmental impact assessment, Tinker et al. (2005) affirm that effects that require mitigation are frequently identified after preparation of environmental statements.

The misperception resulting from multiple regulators in the oil and gas industry may have caused the inadequate implementation of mitigation plans. These mitigation plans could have been carried out as a follow-up program through impact mitigation monitoring. Echefu and Akpofure (2002) stated that the Department of Petroleum Resources and the State Environmental Protection Agencies have enabling instruments that permit them to conduct EIA without limitations. There is the requirement of environmental mitigation plan by EIA regulation in Nigeria. This is set by the federal environmental protection agency (FEPA) and the proponent after the final EIA report should be submitted by stakeholders. If the set mitigation plans are followed, the widespread oil pollutions and social tension in the Niger Delta region could have been reduced.

4.3.3 Implementation of Environmental Monitoring Plan and Post Decision Follow-up

For measuring the environmental effects of impacting activities such as oil spillages from oil and gas development in the host communities of the oil producing companies, environmental effects monitoring programs offer very valuable tools. Environmental effects monitoring programs also provide valuable tools for testing the predictions of the project environmental assessments, identifying emerging concerns and improve mitigation measures (Ingelson, & Nwapi, 2014; Echefu & Akpofure, 2002). It is important to implement physical impact monitoring plans rather than the usual action on paper, as impact monitoring plan is already a legislative requirement for some advanced countries. A report on relevant studies observed and stated that there is a continued absence of environmental monitoring and surveillance systems in the Niger Delta region, even in the face of overwhelming evidence of oil pollutions and environmental degradation (Emoyan, 2008).

Hence, this calls for the adoption and implementation of other relevant tools such as Post Decision Follow-up. This tool will ensure that operating companies would make sure monitoring plans are built into their operations and also include follow-up programs to track the requirements for mitigation measures. The implementation of post decision follow-up is significant an environmental management tool because it is aimed at post decision audit and compliance. Therefore, it is important for the Department of Petroleum Resources (DPR) to design, or delegate the design of, the follow-up program and ensure its implementation. This is also taking into account that the basic elements of a follow-up program are defined in the proponent's environmental impact statements for all oil and gas activities operated in the host communities in Niger Delta.

V. Conclusion

This paper evolves a framework for investigating the causes, sources and preventive measures for marine environmental pollution in Niger Delta, with Akwa Ibom State as a case study. Niger Delta region is one of the most severely petroleum damaged ecosystems in the world. Oil spills from oil and gas exploration and exploitation in the region have caused massive ecotoxicities, degradation of the marine environment and destruction of marine resources, such as seafood, drinking water, occupation, recreational sites and sociocultural heritage. It applies both qualitative and quantitative techniques for data gathering, analysis and interpretation. Data are obtained from 150 respondents within the sample area (Ibena LGA) using questionnaires, focus-group discussion (FGD), personal observations and interviews. Primary and secondary data are drawn randomly from 81 male and 69 females, aged between 16 and 60 years, from four major villages: Upenekang; Mkpamak; Iwoachang; and Inua Eyet Ikot.

The study reveals that crude oil exploitation and production has a negative and statistically significant effect in the Ibena L.G.A., thereby leading to a high rate of marine environmental pollution and degradation in the community. The study shows that the indigenes have suffered a lot of impact from marine pollution degradation caused by oil and gas activities ranging from polluted air and water resources to very high atmospheric temperatures for long periods of time. Based on these devastating effects, the following preventive/control measures are suggested:

- (a) Conduct of public enlightenment and advocacy campaign
- (b) Improvement of the socioeconomic life of coastal communities via infrastructural development.
- (c) Enactment and enforcement of relevant laws against the wanton abuse of the marine environment
- (d) Environmental remediation or routine clean-ups; (e) Proper waste treatment and/or recycling;
- (f) Reorientation and attitudinal change towards proper waste disposal
- (g) Public-private partnership for sustainable development and clean environment;
- (h) Conduct proper impact assessment and pollution containment strategies
- (i) Ensuring good surveillance and preventive maintenance actions
- (j) Periodic sampling and testing of the water bodies as to protect the people from pollution-induced hazards
- (k) Use of pollution monitoring and abatement devices
- (m) Periodic evaluation of pipeline vulnerability assessment for structural integrity, etc. Remember, a healthy, pollution-free environment is our collective wealth.

Acknowledgement

The authors wish to acknowledge Mr. Anietie Udo of the Department of Marine Engineering and Naval Architecture for his contribution in the final draft of this paper.

References

- [1]. Armsworthy, S.L., P.J. Cranford, and K. Lee. (2005). Offshore oil and gas environmental effects monitoring: approaches and technologies. Battelle Press, Columbus, OH.
- [2]. Azetsu-Scott, K., P. Yeats, G. Wohlgeschaffen, J. Dalziel, S. Niven, and K. Lee. (2007). Precipitation of heavy metals in produced water: influence on contaminant transport and toxicity. *Marine Environmental Research* 63: 146-167.
- [3]. Badejo, O.T. and Nwilo, P.C (2004) Oil Spill Problems and Management in the Niger Delta International Oil Spill Conference Proceedings 2005(1):567-570 DOI: 10.7901/2169-3358-2005-1-567

- [4]. Bell, P. W. (1987). Accounting as a discipline for study and practice: British Journal of Educational Psychology online library.wiley.com.
- [5]. Boele, R., Fabig, H., Wheeler, D. (2001). Shell, Nigeria and the Ogoni: A Study in Unsustainable Development: I. The Story of Shell, Nigeria and the Ogoni People- Environment, Economy, Relationships: Conflict and Prospects for Resolution. Sustainable Development, 9, 74–86.
- [6]. Boudreau, P.R. and 23 others. (1999). The possible environmental impacts of petroleum exploration activities on the Georges Bank ecosystem. Canadian Technical Report of Fisheries and Aquatic Sciences 2259, Fisheries and Oceans Canada, Dartmouth, NS.
- [7]. Boufadel, M.C., Y. Shariq, B. Van Aken, B. A. Wrenn, and K. Lee. (2010). Nutrient and oxygen concentrations within the sediments of an Alaskan beach polluted with the Exxon Valdez oil spill. Environmental Science and Technology 44: 7,418-7,424.
- [8]. Cranford, P.J., K. Querbach, G. Maillet, K. Lee, J. Grant, and C. Taggart. (1998). Sensitivity of larvae to drilling wastes (Part A): Effects of water-based drilling mud on early life stages of haddock, lobster and sea scallop. Report of the Georges Bank Review Panel, Halifax, NS.
- [9]. Cranford, P.J., D.C. Gordon, Jr., C.G. Hannah, J.W.Loder, T.G. Milligan, D.K. Muschenheim, and Y. Shen. (2003). Modelling potential effects of petroleum exploration drilling on northeastern Georges Bank scallop stocks. Ecological Modelling 166: 19-39.
- [10]. Cranford, P.J., D.C. Gordon, K. Lee, S.L. Armsworthy, and G.-H. Tremblay. (1999). Chronic toxicity and physical disturbance effects of water- and oil-based drilling fluids and some major constituents on adult sea scallops (*Placopecten magellanicus*). Marine Environmental Research 48: 225-256.
- [11]. Echefu, N. and Akpofure, E. (2002). Environmental impact assessment in Nigeria: regulatory background and procedural framework. EIA Training Resource Manual.
- [12]. Emoyan, O. (2008). The oil and gas industry and the Niger Delta: Implications for the environment. Journal of Applied Sciences and Environmental Management, 12(3).
- [13]. Frynas, J. G. (1999). Oil in Nigeria: Conflict and Litigation Between Oil Companies and Village Communities. Münster: Lit Verlag.
- [14]. Holland, K., Karnis, S., Kasner, D. A., Butler, P. B., Hadley, P. W., Nathanail, P., and Wice, R. (2013). Integrating Remediation and Reuse to Achieve Whole- System Sustainability Benefits. Remediation Journal, 23(2), 5-17.
- [15]. Holstein, J. and Gubrium, J. (1995). The Active Interview. Qualitative Research Methods. Volume 37 London. Sage publications.
- [16]. IMO. (1991). The International Convention on Oil Pollution Preparedness, Response and Co-operation (the "OPRC Convention") of 1990. London: Author.
- [17]. IMO. (2004). The International Convention on Civil Liability for Bunker Oil Pollution. London: r.
- [18]. IMO. (1977). The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (1969). London:
- [19]. IMO. (2011). International Convention on Civil Liability for Pollution Damage. Retrieved from <http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-on-Civil-Liability-for-Oil-Pollution-Damage-%28CLC%29.aspx>.
- [20]. Ingelson, A., and Nwapi, C. (2014). Environmental impact assessment process for Oil, gas and mining projects in Nigeria: A critical analysis. Gas and Mining Projects in Nigeria: A Critical Analysis, 10(1).
- [21]. IPEIA (International Petroleum Industry Environmental Association). (2007). Oil Spill Compensation: A Guide to the International Conventions on Liability and Compensation for Oil Pollution Damage. London: Author.
- [22]. IPIEA (International Petroleum Industry Environmental Association). (2009). A guide to contingency planning for oil spills on water. London: Author.
- [23]. ITOPF (International Tanker Owners Pollution Federation Limited). (2013). Oil Tanker Spill Statistics 2012. Retrieved June 2013, <http://www.itopf.com/news-and-events/documents/StatsPack.pdf>
- [24]. Kerlinger, F. N. (1970). A social attitude scale: Evidence on reliability and validity. SAGE Journals - Sage Publications journals.sagepub.com
- [25]. Nachmias, F. C., and Nachmias, D. (1992). Research methods in the Social Sciences, Volume 1. fourth edition Martin's Press, 1992 - Ciencias sociales.
- [26]. Pandey, P. K., Kass, P. H., Soupir, M. L., Biswas, S., and Singh, V. P (2014): Contamination of water resources by pathogenic bacteria. AMB Express volume 4, Article number: 51. Springer Open.
- [27]. Tinker, L., Cobb, D., Bond, A., and Cashmore, M. (2005). Impact mitigation in environmental impact assessment: paper promises or the basis of consent conditions. Impact Assessment and Project Appraisal, 23(4), 265-280.
- [28]. Wimmer, R. and Dominick, J. (2003). Mass Media Research: An Introduction (8th edn). Belmont, California: Wadsworth

Antai, Emmanuel E, et. al. "A Framework for Investigating Marine Environmental Pollution and Implementation of Control and Preventive Measures for Oil Spillages in Akwa Ibom State." *The International Journal of Engineering and Science (IJES)*, 10(04), (2021): pp. 54-68.