EVALUATION OF SOME OIL COMPANIES IN THE NIGER DELTA REGION OF NIGERIA: AN ENVIRONMENTAL IMPACT APPROACH

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ABSTRACT *The Niger Delta region of Nigeria has no doubt played a major role to Nigeria's growth and acted as the backbone of the Nigerian economy, hence the export of oil and gas resources by the petroleum sector has substantially improved the Nation's economy over the past five decades. Activities associated with petroleum exploration, development and production operations have local detrimental and significant impacts on the atmosphere, soils and sediments, surface and groundwater, marine environment and terrestrial ecosystems in the Niger delta. The Niger Delta consists of diverse ecosystems of mangrove swamps, fresh water swamps, rainforest and is the largest wetland in Africa and among the ten most important wetland and marine ecosystems in the world, but due to oil pollution caused by exploration, the area is now characterized by contaminated streams and rivers, forest destruction and biodiversity loss, in general the area is ecological wasteland. This affects the livelihood of the indigenous people who depend on the ecosystem services for survival leading to increased poverty and displacement of people. Discharges of petroleum hydrocarbon and petroleum – derived waste streams have caused environmental pollution, adverse human health effects, socioeconomic problems and degradation of host communities in the oil producing states in the Niger Delta region. However, the oil industry located within the region has contributed immensely to the growth and development of the country, which is a fact that cannot be disputed but unsustainable oil exploration activities has rendered the Niger Delta region one of the five most severely petroleum damaged ecosystems in the world.*

KEYWORDS: Environmental degradation, Bio-diversity, Gas-flaring, Oil-spillage, petroleum exploration

INTRODUCTION

In August, 1859, Colonel Drake drilled a 70 feet well in Titusville, Pennsylvania and discovered oil, by the 1800's a number of wells were drilled in Pennsylvania, Kentucky and California. The birth of the modern oil industry is credited to the discovery of oil at spindle top in 1901 atop a salt dome near Beaumont Texas (Knowles, 1983).

Petroleum exploration and production in the Nigeria's Niger Delta region and export of oil and gas resources by the petroleum sector has substantially improved the nation's economy over the past five decades. However, activities associated with petroleum exploration, development and production operations have local detrimental and significant impacts on the

atmosphere, soils and sediments, surfaces and groundwater, marine environment, biologically diversity and sustainability of terrestrial ecosystems in the Niger Delta. Oil spillage is a global issue that has been occurring since the discovery of crude oil, which was part of the industrial revalidation.

In 1956, Shell British Petroleum (now Royal Dutch Shell) discovered crude oil at a village Oloibiri in Bayelsa state located within. The Niger Delta of Nigeria (Onuoha, 2008; Anifowose, 2008) and commercial production began in 1958. Oil exploration and exploitation has been on-going for several decades in the Niger Delta. It has had disastrous impacts on the environment in the region and has adversely affected people inability that region disadvantages of petroleum hydrocarbon and petroleum derived waste streams have caused environmental pollution, adverse human health effect, detrimental impact on regional economy, socio-economic problems and degradation of host communities in the 9 oil producing states in the Niger Delta region. Although, there are other anthropogenic sources of pollution, some of the major environmental consequences such as air pollution, global climate change and oil spills in the Niger Delta may be regional or global in scale. Apart from other anthropogenic emission sources, atmospheric pollution in the region is associated with emissions from flaring and venting of petroleum associated natural gas by petroleum industries, (Ogri 2001, Scheren *et al.,* 2002; Ite and Ibok 2012).

Atmospheric contaminants from anthropogenic activities can be categorized into (i) gaseous pollutants, (ii) persistent organic pollutants, (iii) particulate matter and (iv) trace element and/or heavy metals, (Kampa and Castanas, 2008). Release of petroleum hydrocarbons into the environment, whether accidentally or due to anthropogenics activities, it is a major cause of controlled water and soil pollution, (Benka-Coker and Ekundayo 1995; Benka-Coker and Olumajin 1996; Holliger *et al.,* 1997, Kharaka *et al.,* 2007) and may also contribute to regional atmospheric pollution. (Ite and Ibok 2013).

Petroleum is a naturally occurring complex mixture made up predominantly of hydrocarbon compounds and frequently contains significant amounts of nitrogen, sulphur, and oxygen together with smaller amounts of nickel, vanadium, and various elements. Petroleum compounds can occur in solid form as asphalt, liquid form a crude oil and/or gaseous form as natural gas. Petroleum hydrocarbons could be divided into four classes: saturates (Pentane, hexadecane, octacosane, cyclohexane), aromatics (naphthalene, phenanthrene, bencene, pyrene), asphaltenes (phenols, fatty acids, ketones, esters, and porphyrins), and resins (pyridines, quinolines, carbazoles, sulfoxides and amides) (Cowel and Walker 1977; Ite and Semple 2012).

Soils and sediments are the ultimate sink for most petroleum contaminants, such as benzene, toluene, ethyl benzene, and xylenes, aliphatic and polycyclic aromatic hydrocarbons (PAHS). Petroleum hydrocarbon contamination of soils and sediment is a global concern because of the toxicity (Ite and Semple, 2012) and refractory character of the aromatic components in the absence of oxygen (Aderson and Lovley, 1997), PAHs, which make up about 5% by volume, are a widespread class of environmental chemical contaminants of anthropogenic, or natural origin.

Inadvertent discharges of petroleum hydrocarbons into the environment often pose threats to human health, safety and the environment and have significant, socio-economic consequences. Evidence of acute and chronic toxicity demonstrates the potential toxic and negative impacts of petroleum-derived wastes on the tropical environment. (Holdway, 2012).

However, some of the multinational oil companies operating in the Niger Delta region have failed to adopt best practice strategies for risks mitigation and comply with environmental regulations. The poor environmental management practices by the petroleum industries and the failure of Nigeria's environmental regulations contribute towards environmental contamination with direct consequences on the surrounding populations socio-economic wellbeing, human health and the environment.

Environmental contamination, human health risks, safety and the environment, and negative socio-economic consequences of most petroleum pollutants in the world depend on the intersection of the event, the geographic setting, the characteristics of the regional population, corporate governance systems and political economy. Environmental contamination and degradation associated with both onshore and offshore petroleum exploration and production operations in the higher Delta has not yet been properly addressed for the past five decades.

Objectives

This paper aims at the various environmental problems associated with oil exploration and spillage in specifically the Niger Delta in Nigeria. As well as bring into perspective the environmental impact occurring in an important, reproductive wetland and marine ecosystem contribution to the Federal Government for Nigeria, States, Local Governments of the Niger Delta region, Oil companies, Nigerian National Petroleum co-operation, Institutions, Host communities, Researches and the existing body of knowledge on oil spillage and environmental degradation in the Niger Delta region of Nigeria. It will enlighten and sensitize relevant authorities on the problem within the Niger Delta region of Nigeria with recommendations that would be made arising from the study, which will help policy makers on future plans.

Also the paper brings into perspective the environmental impact occurring in an important reproductive wetland and marine ecosystem and assess the extent of the environmental degradation that has occurred for years.

The paper also serves as a useful reference materials and catalyst that will stimulate future researchers.

BACKGROUND ON THE NIGER DELTA REGION

Nigeria has a coastal line of approximately 85km towards the Atlantic Ocean lying between latitude $4^015'$ to $4^050'$ and longitude $5^025'$ to $7^037'$ with a land mass of about 28000sq/km. The coastal areas consist of freshwater swamp, mangrove swamp, beach ridges, sand bars, lagoons marshes and tidal channels. Nigeria has a total land mass of 923,768sq/km; 918,768sq/km being terrestrial land and 13000 sq/km being aquatic (CIA World Fact Book). The coastal area is humid with a mean average temperature of 24-32^0C and coastal area has an average annual rainfall ranging between 1,500- 4,00m (Kuruk, 2004). Nigeria has two large rivers; the Niger-Benue and the Chad River. There are several rivers that channel into the Atlantic Ocean directly, all other flowing waters flow into the Chad basin or into the lower Niger to the sea eventually (Kuruk, 2004).

The Niger Delta is located in the Atlantic coast of Southern Nigeria and is the world's second largest delta with a coastline of about 450km which ends at Imo river entrance (Awosika,

1995). The region is about 20,000sq/km as it is the largest wetland in Africa and among the third largest in the world (Powell, *et al.,* 1985; CLO, 2002; Anifowose, 2008; Chinweze and Abiola-Oloke, 2009). 2,370sq/km of the Niger Delta are consists of rivers, creeks, estuaries and stagnant swamps cover approximately 8600sq/km, the Delta mangrove swamp spans about 1900sq/km as the largest mangrove swamp in Africa (Awosika, 1995). The Niger Delta is classified as a tropical rainforest with ecosystems comprising of diverse species of flora and fauna both aquatic and terrestrial species. The region can be classified into four ecological zones; coastal inland zone, freshwater zone, lowland rainforest zone, mangrove swamp zone and this region is considered one of the ten most important wetlands and marine ecosystems in the world (FME, *et al.,* 2006; ANEEJ, 2004). As of 1991, the National Census estimated about 25% of the entire Nigerian population lives within the Niger Delta region (Twumasi and Merem, 2006; Uyigue and Agho, 2007). The Niger Delta region has a steady growing population of approximately 30million people as of 2005, accounting for more than 23% of Nigeria's total population (Twumasi and Merem, 2006; Uyigue and Agho, 2007).

HISTORICAL PERSPECTIVE OF OIL AND GAS EXPLORATION AND PRODUCTION

Petroleum resources exploration in Nigeria dates back to 1908, when German surveyors for the Nigerian Bitumen Corporation, began prospecting for Tar Sand deposit in the South Western Nigeria. These pioneering efforts ended abruptly with the outbreak of the World War I in 1914. Exploration of petroleum resources did not begin until 1938, when Shell D'Arcy (a consortium of Iranian Oil Company (later British Petroleum) and Royal Dutch Shell) was granted a sole concessionary right over the whole country. However, World War II (1939-1945) terminated the initial oil exploration activities by Shell D'Arcy. Oil exploration in the Nigeria's Niger Delta resumed in 1946 after World War II and Shell D'Arcy drilled a number of oil exploration wells in 1951.

At the initials stage, shell D'Arcy (later shell British Petroleum) enjoyed a complete monopoly of oil exploration for a considerable long time (1938 – 1955). Thereafter, mobile producing (Nigeria) Ltd., a subsidiary of American Socony-Mobile Oil Company, obtained license to explore for oil and began operations in Nigeria in 1955 under the name mobile Exploration Nigeria Incorporated (which was later incorporated as Mobile Producing Nigeria on June 16, 1969). The first commercial oil discovery in the tertiary delta was confirmed at Oloibiri field in January, 1956 by Shell D'Arcy (later Shell-British Petroleum) and a second oil field was later discovered at Afan (Haack *et al.,* 2000; Vassiliou 2009).

In February, 1958, Shell British Petroleum (now Royal Dutch Shell) started exporting crude oil produced from Oloibiri and Afan Oil Field Station Port Harcourt, (Pearson, 1970).

The giant Bornu Oil Field, which has Estimated Ultimate Recovery (EUR) of 0.311 billion of barrels (BB) of oil and a total of 0.608 billion of barrels of oil equivalent (BBOE) including gas was discovered southeast of Port Harcourt, Rivers state in 1958, (Vassiliou, 2009).

The petroleum sector began to play a vital role in shaping the Nigerian economy and political destiny of the country in the early 1960s. When Nigeria became an independent nation on 1st October, 1960, Shell-BP began to relinquish its acreage and its exploration licenses were converted into prospecting licenses that allowed development and production (Vassiliou

2009; Bamberg, 2000). Following the increase dominance of the Nigerian economy by petroleum sector, the sole concession policy was abandoned and exclusive exploration right was introduced to encourage other multinational oil companies aimed at accelerating petroleum exploration and production. Other multinational oil companies joined oil and gas exploration in Nigeria and these include Texaco Overseas Nigeria Petroleum Company Unlimited in 1961, Amoseas in 1961, Gulf Oil Company in 1961 (now Chevron), Societe Africaine des Petroles (SAFRAP) in 1962 (which later became ELF Nigeria lLimited in 1974), Tennessee Nigeria Limited (Tenneco) in 1962, Azienda Generale Italiana Petroli (AGIP) in 1962, ENI in 1964, Philips Oil Company in 1964 and Pan Ocean Oil Company in 1972. Most of these multinational Oil Companies recorded considerable successes in oil and gas exploration and production in both onshore and offshore fields in the Niger Delta.

The Federal Government of Nigeria started its Department of Petroleum Resources (DPR) Inspectorate in 1970 and Nigeria joined the Organization of the Petroleum Exporting Countries (OPEC) in 1971. The first National Oil Company, the Nigerian National Oil Corporation (NNOC) was created in 1971 and it later became the Nigerian National Petroleum Corporation (NNPC) in 1977. In order to take control of the country's petroleum industry, Nigeria nationalized BP's holding completely in 1979, and shell-BP became Shell Petroleum Development Companyof Nigeria (SPDC), (Genova 1970-1980; Ann Arbor 2007).

Although, several other oil companies have joined in exploration and production over the past decades, SPDC has the largest acreage in the country from which it produces some 39 percent of the nation's oil and remains the major producer in the Nigeria's petroleum industry. the Niger Delta region is richly endowed with 31 giant oil and gas fields and each has an estimated ultimate recoverable oil of more than 500 million barrels and produces in excess of 1million barrels a day out of the Nation's total production of about 2.1million barrels per day, (Obaje, 2009).

According to Vassihou (2009), 17 of giant oil and gas production fields are located offshore and some of the examples include Bomu, Oso, Ubit, Assan, Meren, Abo, Bonga, Bonga Southwest and Agbami, etc. Bonga and Bonga Southwest were discovered in 1996 and 2001, respectively and are operated by a joint venture lad by SPDC, (Vassihou, 2009). Currently, there are over 18 multinatinal oil companies which are involved in oil and gas exploration and production in the Niger Delta, (Piondexter *et al.,* 2008), and the major players include Dutch Shell, Exxon Mobil, ENI/Agip, Total Fina ELF and US-based Chevron Texaco.

ENVIRONMENTAL REGULATION OF OIL AND GAS EXPLORATION AND PRODUCTION IN NIGERIA

There are many approaches that have been developed for the safety and management of environmental impact of oil and natural gas exploration and production operations in the Niger Delta. The emergence of Niger Delta as one of the most ecologically sensitive regions in Nigeria has led to the institutionalization of several statutory laws and environmental regulations to regulate the Nigerian petroleum industry. Over the past years, the Nigerian Federal Government has promulgated laws and regulations so that oil and gas exploration and production operations, on both onshore and offshore oilfields, could be controlled by systems of limits which aim at minimizing the associated environmental impacts. Some of the related

environmental laws and regulations in the oil and gas sector include Oil Pipelines Act 1956 (amended in 1965); Mineral Oils (safety) Regulations (1963); Oil in Navigable Waters Acts (1968); Petroleum Acts (1969); Associated Gas Re-injection Act (1979); the Federal Environmental Protection Agency (FEPA) Act (1988); the National Policy on the Environment, (1989); (revised in 1999); National Environmental Protection (Effluent Limitations), Regulations (1991); Environmental Protection (Pollution Abatement in Industries Generating Wastes) Regulations (1991); Environmental Impact Assessment (EIA) Act (1992), and Department of Petroleum Resources (DPR) Environmental Guidelines and Standard for the Petroleum Industry in Nigeria (EGASPIN) (2002). According to Salu, (1993), most of these statutory laws and regulations provide the framework for petroleum resources exploration and exploitation in Nigeria and only some of these environmental regulations give guidelines on issues of petroleum pollution. Although, the environmental laws and regulations in Nigeria have been poorly implemented, numerous environmental agencies have regulations that affect the exploration, development and production operations in the petroleum industry in Nigeria.

The establishment of FEPA in 1988 significantly changed the legal status quo of environmental regulation in the Nigeria petroleum industry. Under the 1988 FEPA Act, penalties and enforcement mechanisms were imposed, multinational oil companies could be held liable for costs of cleanup, restoration and multinational oil companies could pay compensation to parties injured by their illegal practices. However, the existing statutory laws and regulations for environmental protection applicable to the Nigerian petroleum industry appear to be grossly inadequate and ineffective. For example, Eaton, (1997) has extensively discussed the five major statutory defects which seriously prevent effective environmental regulation and non-legal explanations for Nigeria's failure to effectively regulate the activities of multinational oil companies. The government's environmental regulations are often affected by the limitations of technology, the need to support industry and the influence of public opinion. In the Nigeria's Niger Delta, the participation of communities in the environmental decision-making process is a relatively new process and often ineffective with little or no sustainable development goals. Over the past fifty years, the multinational oil companies operating in the Niger Delta region have failed to adopt sustainable exploration and production practices due to increased costs of complying with environmental regulations. Although, comprehensive system of environmental regulations is now in place, environmental pollution associated with oil and gas exploration and production operations has continued to persist under these laws for several reasons. Therefore, unsustainable petroleum exploration and production practices and poor environmental management practices has impacted on the atmosphere, controlled waters, soils and sediments, biological diversity and sustainability of the natural ecosystem in the Niger Delta for several decades.

OIL PRODUCTION IN NIGERIA

Nigeria has been a member of Organization of Petroleum Exporting countries (OPEC) since 1971. It has the largest natural gas reserve in Africa, has the second largest oil reserve in Africa and is the African continents primary oil producer. As of the 1980s oil revenue provided 90% of Nigeria foreign exchange earning and 85% of the government revenue (Odeyemi and Ogunseitan; 1985), with estimated reserves extending beyond 20-30 years (NNPC, 1984). Shell D'Arcy the pioneer oil company in Nigeria, which started commercial production in 1958 with a production rate of 5100 barrels per day and a peak production rate

of 2.44 million barrels per day over the next few years (Amu, 1997). According to NNPC (1984) through OPEC, production rates dropped to 1.5million barrels per day from the activities of 10 international companies working 122 fields, containing over 970 oil wells. Nigeria has four oil refineries with an estimated total refining capacity of 445,000 barrels per day (Onuoha, 2008; Anifowose, 2008). The first and oldest being the Port Harcourt refinery, commissioned in 1965. It had an initial capacity of 35,000 barrels per day, which was later expanded to 60,000 barrels per day of light crude oil. The Port Harcourt refinery has a second refinery with a capacity of 150,000 barrels per day (Odeyemi and Ogunseitan 1985; Ukoli 2005). Anifowose (2008) and Onuoha (2008) cited in their studies that the region has about 606 oil fields with 355 situated onshore; 251 situated offshore with 5,284 drilled oil wells and 7,000km of oil and gas pipelines.

BIODIVERSITY IN THE NIGER DELTA

The ecosystem of the area is highly diverse and supportive of numerous species of terrestrial and aquatic fauna and flora as well as human life (Uyigue 2009). The Niger Delta has been declared as a key zone for the conservation of the western coast of Africa on the basis of the extraordinary biodiversity (Nenibarini, 2004). It is estimated, that in Nigeria there are more than 46,000 plant species of which about 205 are endemic, and approximately 484 plants in 112 families are threatened with extinction as well as many animal and bird species (Salau, 1993). Another estimate is that 24 out of 274 mammal, 10 out of 831 birds and 2 out of 114 reptiles known to exist in Nigeria are endangered (WRI, 1992). The larger population of the Niger Delta survive on services provided by the ecosystem; agriculture, industry, fishing, food, drinking water, wood, shelter, medicine, employment and aesthetics. All aspect of oil exploration and exploitation has adverse effects on the ecosystem and the local biodiversity. Oil exploration by seismic oil companies involves clearing of seismic lines, dynamiting for geological excavation, which affects the aquatic environment. It causes mortality in fauna, turbidity in the water that blockage of gills of the filter feeders in the benthic fauna, reduction of photosynthetic activity caused by the water turbidity that reduces the amount of sunlight penetration.

OIL SPILLAGE

An estimated 9 million-13million (1.5million tons) of oil has been spilled into the Niger Delta ecosystem over the past 50years; 50 times the estimated volume spilled in Exxon Valdez oil spill in Alaska 1989 (FME, NCF, WWF UK, CEESP-IUCN 2006). The first oil spill in Nigeria was at Araromi in the present Ondo state in 1908 (Tolulope, 2004). In July, 1979 the Forcados tank 6 Terminal in Delta state incidence spilled 570,000 barrels of oil into the Forcados estuary polluting the aquatic environment and surrounding swamp forest (Ukoli, 2005; Tolulope, 2004). The Funiwa No. 5 well in Funiwa Field blew out an estimate 421,000 barrels of oil into the ocean from January 17th to January, 30th 1980 when the oil flow ceased (Ukoli, 2005; Gabriel, 204; Tolulope, 2004), 836 acres of mangrove forest within six miles off the shore was destroyed. The Oyakama oil spillage of 10th May, 1980 with a spill of approximately 30,000bbl (Ukoli, 2005).

In August, 1983 Oshika village in River state witnessed a spill of 5,000 barrels of oil from Ebocha-Brass (Ogada-Brass 24) pipeline which flooded the lake and swamp forest, the area had previously experienced an oil spill of smaller quantity; 500 barrels in September 1979 with mortality in crabs, fish and shrimp. Eight months after the occurrence of the spill there was high mortality in embryonic shrimp and reduced reproduction due to oil in the lake sediments (Gabriel, 2004). The Ogada-Brass pipeline oil spillage near Etiama Nembe in February 1995 spilled approximately 24,000 barrels of oil which spread over freshwater swamp forest and into the brackish water mangrove swamp. The Shell Petroleum Development Company (SPDC) since 1989 recorded an average of 221 spills per year in its operational area involving 7,350 barrels annually (SPDC Nigeria Brief, May 1995:3). From 1976-1996 a total of 4647 oil spill incidences spilling approximately 2,369,470 barrels of oil into the environment of which 1,820,410.5 (77%) were not recovered. Most of these oil spill incidences in the Niger Delta occur on land, swamp and the offshore environment (Nwilo and Badejo 2005a, 2005b, 2004; Twumasi and Merem, 2006; Uyigue and Agho 2007). NNPC estimates 2.300 cubic meters of oil has spilled in 300 separate incidences annually between 1976-1996 (Twumasi and Merem, 2006). Table 1 below shows some of the oil polluted sites in the Niger Delta region.

Table 1: Some severally oil polluted sites in the Niger Delta

Location	Environment	Impacted Area (ha)	Nature of Incidence
Bayelsa state			
Biseni	Freshwater Swamp Forest	20	Oil Spillage
Etiama/Nembe	Freshwater Swamp Forest	20	Oil Spillage & Fire Outbreak
Etelebu	Freshwater Swamp Forest	30	Oil Spill Incidence
Peremabiri	Freshwater Swamp Forest	30	Oil Spill Incidence
Adebawa	Freshwater Swamp Forest	10	Oil Spill Incidence
Diebu	Freshwater Swamp Forest	20	Oil Spill Incidence
Tebidaba	Freshwater Swamp Forest Mangrove	30	Oil Spill Incidence
Nembe creek	Mangrove Forest	10	Oil Spill Incidence
Azuzuama	Mange	50	Oil Spill Incidence
9 sites			
Delta state			
Opuekebe	Barrier Forest Island	50	Salt Water Intrusion
Jones creek	Mangrove Forest	35	Spillage & Burning
Ugbeji	Mangrove	2	Refinery Waste
Ughelli	Freshwater Swamp Forest	10	Oil Spillage-Well head leak
Jesse	Freshwater Swamp Forest	8	Production leak/burning
Ajato	Mangrove		Oil Spill Incidence
Ajala	Freshwater Swamp Forest		Oil Spill Incidence
Uzere	Freshwater Swamp Forest		Oil Spill Incidence
Afiesere	Freshwater Swamp Forest		Oil Spill Incidence
Kwale	Freshwater Swamp Forest		Oil Spill Incidence
Olomoro	Freshwater Swamp Forest		QC
Ughelli	Freshwater Swamp Forest		Oil Spill Incidence

Ekakpare	Freshwater Swamp Forest	Oil Spill Incidence
Ughuvwughe	Freshwater Swamp Forest	Oil Spill Incidence
Ekerejegbe	Freshwater Swamp Forest	Oil Spill Incidence
Ozoro	Freshwater Swamp Forest	Oil Spill Incidence
Odimodi	Mangrove Forest	Oil Spill Incidence
Ogulagha	Mangrove Forest	Oil Spill Incidence
Otorogu	Mangrove Forest	Oil Spill Incidence
Macraba	Mangrove Forest	Oil Spill Incidence
20 sites		Oil Spill Incidence
Rivers state		
Rumuokwur usi	Freshwater Swamp	Oil Spillage
Rukpoku	Freshwater Swamp	Oil Spillage

Source: FME, NCF, WWF UK, CEEP-IUCN 2006 Niger Delta Resource Damage Assessment and Restoration Project.

The Punch Newspaper on February 20, 1991:2 reported a total of 2,796 oil spill incidences recorded between the periods of 1976-1990 leading to 2,105,393 barrels of oil spilled. The UNDP 2006:181 also reported that between the period of 1976-2001, 3 million barrels of oil were lost in 6,817 oil spill incidences of which over 70% of the spilt oil was not recovered. In 2001 the western operations of the Shell Petroleum Development Company (SPDC) recorded a total of 115 incidences of oil spills in which 5,187.14 barrels of oil were spilled and 734,053 barrels of the spilt oil representing 14.2% were recovered (SPDC Nigeria Brief, May, 1995). In January, 1998, 40,000 barrels of crude oil was spilled by Mobil in Eket but the largest spill in Nigeria was the offshore well blowout in January 1980 with a spill of approximately 200,000 barrels of oil into the Atlantic Ocean from an oil facility which damaged 340 hectares of mangrove forest (Nwilo and Badejo, 2005b). Table below gives the number of oil spills into the marine environment reported between the periods of 1997-2001. The Niger Delta has a complex and extensive system of pipelines running across the region and large amounts of oil spill incidences have occurred through the pipelines and storage facility failures, these failures could be caused by material defect, pipeline corrosion, ground erosion but the oil companies blame most of the spills on sabotage. The Department of Petroleum Resources contends that 88% of the oil spill incidences are traceable to equipment failure, main causes of oil spills in the Niger Delta are vandalism, oil blowouts from the flow stations, accidental and deliberate releases and oil tankers at sea (Nwilo and Badejo; 2004, 2005a).

GAS FLARING

The energetic solution Conference (2004) estimates that the Niger Delta region has about 123 gas flaring sites. Agbola and Olurin (2003) stated that about 45.8 billion kilo watts of heat is discharged into the atmosphere from 1.8billion cubic feet to gas daily in the Niger Delta region, leading to temperatures that render large areas inhabitable. Complete utilization of produced associated gas, reduction of flaring and production greenhouse gas is one of the policies that oil companies are expected to comply, with the stoppage of gas flaring completely by 2004 or 2008. Still 84.60% of total gas produced is still flared with 14.86% only being used locally (Ukoli, 2005). From 197-1986 a total of 125.5 cubic meters approximately of gas was produced in the Niger Delta region, 102.3 (81.7% million cubic

meters was flared, 2.6 million cubic meter was used as fuel by the oil producing companies and about 14.6 million cubic meters was domestically consumed (Awosika, 1995). In 2004 Nigerian Liquefied Natural Gas pipeline transversing through Kala-Akama, Okrika mangrove forest leaked and set ablaze and burnt for three days. The local plant and animals within the areas were engulfed (Nenibarini, 2004). Apart from this fire incidence over several decades there has been many well documented cases of fire incidences that have resulted in a large number of human fatalities.

Acid rain is another problem within the Niger Delta region caused by gas flaring which has led to loss in biodiversity, with forest and economic crops being destroyed. The dominance of grasses and shrubs in some parts of the region is indication of loss of natural forest, this may be due to acid rain but other factors maybe the cause such as agricultural activities and the exploration and exploitation of oil companies (Uyigue and Agho, 2007; Opukria and Ibaba, 2008). The concentration of acid in rain water appears to be higher in the Niger Delta region and decreases further away from the region (Uyigue and Agho, 2007). The heat generated from gas flaring kills vegetation around flaring area, destroys mangrove swamps and salt marshes, suppresses the growth and flowering of some plants, induces soil degradation and diminishes agricultural productivity (UNDP, 2006; Mba, 2000). A study by Salau (1993) and Adeyemo (2002) about the impact of gas flaring on agriculture showed a direct relationship between gas flaring and productivity decline in agriculture as shown below in Table II.

Table 2: The impact of Gas Flaring of Agricultural Output.

Distance of farmland from flare site	Percentage loss in yield of crops
200 meters	100 percent
600 meters	45 percent
1 kilometer	10 percent

Source: Salau, 1993:19-22, Adeyemo, 2002:69.

Gas flaring is related oil spillage and UNDP, 2006 estimates that Nigeria flares 75% of the gas it produces which is more than any other country in the world. Table 3 below shows some of the global gas flaring estimates in some of the major oil producing countries.

Table 3: Flaring of Natural Gas in major producing countries (% of Gross Production in 1991).

Country	Percentage
United State of America (USA)	0.6
Holland	0.0
Britain	4.3
Former Union of Soviet Socialist Republic (USSR)	1.5
Mexico	5.0
OPEC Countries	
Nigeria	76.0
Libya	21.0
Soudi Arabia	20.0
Algeria	19.0
OPEC Total	18.0
World Total	4.8

Source: World Bank Report, 1995, vol. 1:59

Apart from the above issues the toxicity to humans causing respiratory illness, leading to kidney disease, neurological disease and potential death (Ndubisi and Asia 2007). Oil exploration and exploitation activities such as this have significantly contributed to the environmental degradation of the Niger Delta region in spite of government measures to stop gas flaring by 2008 and the existence of monitoring agencies, regulations and standards, the flaring activities in the area is still a problem. Gas flaring in the area is a major source of Cox, Nox, Sox and particulate matter and the cumulative environmental impact of these flaring activities result in contaminant build up on land, shallow ground water, greenhouse effect and general global warming and have also caused high concentration of acid rain within the region.

IMPACT OF PETROLEUM HYDROCARBON IN THE ENVIRONMENT

In terms of organisms, they vary greatly in their sensitivity of petroleum hydrocarbons and predicting the environmental impacts of specific releases of a quantity of petroleum hydrocarbon requires much site specific information about the nature of the receiving body. Most of what is known about petroleum hydrocarbons comes from studies of catastrophic oil spills. Effects tend to reflect the amount of toxic hydrocarbon in the environment and the different susceptibility of organisms, population and ecosystems and doses are rarely directly proportional to the amount released; one must consider the type of petroleum hydrocarbon released and the susceptibility of the organisms due to the environmental processes acting on the released petroleum hydrocarbon. The toxicity to the organism will depend on the available dose of petroleum available to an organism.

When petroleum hydrocarbon is released into the environment, processes alter the chemical composition of the petroleum hydrocarbon which alters the toxicity. Physical weathering may transform the petroleum hydrocarbon to a form less available to the organism. The chemical can physical properties of the petroleum hydrocarbon components determine the rate it passes into an organism. The bioavailability and persistence of specific hydrocarbons, the ability of

an organism to accumulate and metabolize, fate of the metabolized products, metabolites of the hydrocarbon inter-phase with the normal metabolic process may alter an organisms chances of survival and reproduction in the environment. The narcotic effect of hydrocarbon on nerve transmission is the major biological factors in determining the ecological impacts of any release; other factors include photo-degradation and photo-activation. Birds and mammals are vulnerable to oil spills when their habitats become contaminated and this may reduce reproductive rates, survival and physiological impairment (Briggs, *et al.,* 1996). In water, oil film floating on the water surface prevents natural aeration and leads to death to fresh water of marine life and on land lead to retardation of vegetation growth, cause soil infertility for a long period of time (Ukoli, 2005).

Ukoli, 2005 in his study made a summary of some significant pollutants from the oil industry released into the environment as follows:

1.   Exploration and Production activities include: Drilling muds, Cuttings, Oil and Greases, Salinity, Sulphides, Turbidity, Suspended Solids, Temperature, pH, Heavy metals, Biological Oxygen Demand and COD.

2.   Petroleum refining activities include; Oil & Greases, BOD, COD, Phenol, Cyanide, Sulphide, Suspended solids, Toxic additives, Hydrocarbons and Total Suspended Solids.

Effects can be either direct damage of a resource or the ability of the environment to support a resource, an effect is only said to be over when complete recovery has taken place. To quantify the effects and recovery is difficult; damage to a small area containing highly valued resources can be of greater significance than damage to a much larger area devoid of valued resources. The US DOE has reported that the Niger Delta area has experienced 4,000 oil spill incidences since 1960. This has resulted in the loss mangrove trees due to the inability of the mangrove trees to withstand the high toxicity levels of the petrochemicals spilled into the habitat. The spills have also has adverse effects on the marine habitat which has become contaminated. This poses enormous human health risk from the consumption of contaminated seafood (Twumasi and Merem, 2006). The environmental problems of the Niger Delta result in generally land resource degradation, renewable resource degradation and environmental pollution, agricultural land degradation, fisheries depletion, deforestation, biodiversity loss, oil pollution, gas flaring and mangrove degradation.

GENERAL ENVIRONMENTAL INPUT OF OIL SPILL EFFECT ON MANGROVES

Damage to mangrove forests varies with the amount and toxicity of the spilled oil product. The degree of impact is a function of oil type, spill volume, duration or re-oiling, extent of oil coverage on exposed roots, degree of substrate oiling (NRC, 2003). Light oils are acutely toxic while heavier oil can lead to eventual death by smothering. Black mangroves are the most sensitive because they osmoregulate by passing material through the roots and vascular system and then out of the leaves through specialized glands on the leaf surface. When black mangroves are oiled this osmoregulatory process aids oil uptake (Getter, *et al.,* 1985). The Niger Delta is highly susceptible to adverse environmental changes occasioned by climate changes because it is located in the coastal region of the world (Uyigue and Agho, 2007). The area is environmentally rich it consist of primarily mangrove swamp with areas of fresh water

swamp and rainforest (Odeyemi and Ogunseitan, 1985). It has a network of streams and tributaries interlinking, the rivers are the main source of portable water for many towns and villages (Tolulope, 2004). Many species of plants and animals within the mangrove forest have become endangered or at the verge of extinction. Lewis (1981) proposed a generalized response stage of oil mangroves based on his experience at spills in Florida (T/V Howard Star) and Puerto Rico (T/V Zoe Colocotronic). Lamparelli, *et al.,* 1997 conducted a nine year research on crude oil spill site along a tidal channel in Brazil as shown below in Table 4.

Table 4: Proposed stages of impact and Recovery of Oiled Mangroves

Author	Stage/phase	Response
Lewis, 1981	Acute	
	0-15 days	Death of birds, turtles, fish, and invertebrates
	10-30 days	Defoliation and death of small (<1m) mangroves; loss of aerial root community
	Chronic	
	30 days – 1year	Defoliation and death of medium (<3m) mangroves, tissues damage to aerial roots
	1-5 years	Death of larger (>3m) mangroves; loss of oiled aerial roots and regrowth of new ones (sometimes deformed); recolonization of oiled damaged areas by new seedlings.
	1-10 years	Reduction in litter fall, reduces reproduction, and reduced survival of seedlings; death or reduced growth of young trees colonizing oiled sites? Increased insect damage?
	10-15 years	Complete recovery
Lamparelli *et al.,* 1997	Initial Effect	
	0-1 year	Seedling and saplings die; no structural alterations can be measured
	Structural damage	
	1-4 years	High motility is observed, and the oil impact can be measured in terms of major structural alterations.
	Stabilization	
	4-9 year	No or few additional alterations to the structural parameters; sapling growth is observed.
	Recovery	
	> 9years	It is possible to measure improvements in the structural tree parameters; ecosystem may not recover fully to its original state.

Source: NRC, 2003

Wetlands naturally have the ability to break down and assimilate pollutants, which is a resource applicable to the Niger Delta region. The forest cover within the region serves as a climate control, which regulates local climate at macro and micro levels. The canopies within the water catchment areas maintain hydrological cycles and soil stabilization, which prevents erosion and are important in watershed regulations (Chinweze and Abiola-Oloke, 2009). The

clearing of vegetation within the region has many adverse effects such as: Stalinization of water table, declination of water quality, adds silt to the marine ecosystem due to mangrove clearing. A lot of plants found within the region are used for medicine and insect repellent. Also raw material used by many industries in Nigeria such as: starch, ink, rubber, gums, fibres are found within the region.

ENVIRONMENTAL DEGRADATION IN THE NIGER DELTA AND ITS EFFECT ON THE PEOPLE

In terms of environmental changes occurring within the region, large areas of mangrove forest have been destroyed which is a major source of wood to the indigenous people. When oil spills occur, the oil spreads over a wide area affecting terrestrial and marine resources. Some past spills have necessitated the complete relocation of some communities, loss of ancestral homes, pollution of fresh water, loss of forest and agricultural land, destruction of fishing grounds and reduction of fish population, which is the major source of income for the Niger Delta people. Which all constitute massive unquantifiable losses to farmers, fishermen and hunters (Ukoli, 2005). The pollution exposes people also to new risk of diseases.

A study by Twumasi and Merem (2006) about the Niger Delta forest area made assessments using Geo spatial Data processing and Analysis; Two Landsat Thematic Mapper I and Enhanced Thematic Mapper plus (ETM+) images, the analysis was for the period 1985-2005. The results showed a slight decline in water bodies from 343,654 to 343,513 hectares, mangrove and closed forest showed a decline from an initial estimate of 55,410 hectares in 1985 tom 37,117 hectares and closed forest from 250,161 hectares in 1985 to 175,609 hectares, the results of the study is shown below in table 5.

Table 5: Decline of Mangrove and Closed Forest in the Niger Delta

Classes	Area (ha) in 1985	Area (ha) in 2000	% change (1985-2000)
Water	343,654	343,513	-0.04
Crop land	16,495	23,974	45.34
Settlement/bare areas	52,738	108,725	106.16
Mangrove	55,410	37,117	-33.01
Closed forest	250,161	175,609	-29.80
Mixed forest	162,916	192,436	18.12

Source: Twumasi and Merem, 2006

METHODOLOGY

This involved obtaining data from past and present studies, government and non-government bodies and existing literature (Twumasi and Merem, 2006; Uyigue and Agbo, 2007; Uyigue and Ogbeibu, 2007). The study relied on secondary data. Data was obtained from the Nigerian National Petroleum Co-operation, World Bank Report, National Bureau of Statistics, United Nations Environmental Protection Programme, Amnesty International, International Monetary Fund, Published and unpublished materials, Books, Newspapers, Conferences and Seminar papers, Journals and the Internet. The data obtained was analyzed

using descriptive method to obtain logical deductions and sequential presentation of facts from the data obtained to give a clear picture of the problem.

RESULTS

From the literature review of the oil exploration and exploitation activities in Nigeria, oil development activities have contributed to the growth and development of the country in general. There is no doubt that oil has been of great benefit to the Nigerian state and the people as a whole but the oil pollution caused by spillages from the oil industry located primarily in the Niger Delta region has caused the massive destruction to farmlands, sources of drinking water, mangrove forest, fishing grounds and declination of fish, crabs, mollusks, periwinkles and birds. Large areas of mangrove forest have been destroyed over a wide area affecting terrestrial and marine resources. Some past spills have necessitated the complete relocation of some communities, loss of ancestral homes, pollution of fresh water, loss of forest and agricultural land, destruction of fishing grounds and reduction of fish population, which is the major source of income for the Niger Delta people (Tolulope, 2004; CAB, 2009).

DISCUSSION OF FINDINGS

In terms of the environmental problems associated with oil exploration in the Niger Delta. In the past based on the oil spill occurrence, a lot has happened in terms of degradation of the environment. The problem with oil is that even years after a spillage, without proper clean-up and remediation, oil persists in the environment. Even with remediation it takes up to 15 years for recovery and factors like the geology of the area and the type of oil will also determine the recovery period. The quantity of oil spilled is also relevant to recovery period but is not the major determinant of the recovery period and the type of cleanup method also determines recovery period. It is seen from areas like in Ogoni land that oil spills that occurred before the early 1990s with no remediation and subsequent spill from pipeline have rendered area a wasteland.

The government should be commended in that now they are tackling the problem with the UNEP with collaborations with UN (United Nation), which is taking steps towards finding a permanent solution or remediation for Ogoni land. The SPDC has to be commended also for the sponsorship of this activity and their readiness finally in taking steps into the remediation of Ogoni land.

CONCLUSION

Although, the activities that come with the oil exploration and exploitation causes alterations to the environment. Which significantly have negative effects; some of the effects that come with petroleum development can be reduced or prevented basically by taking some steps in terms of prevention. Monitoring is also essential, but is lacking in the Niger Delta region. Monitoring the location of the oil companies; the terrain, the accessibility, revenue, man

power availability for the monitoring agency, qualified personnel are not available. This restricts the ability and efficiency of monitoring by the government.

Environmentalist and people generally give blame to the oil companies but the Federal Government provides the laws, legislations and license, which the oil companies must adhere too. The Federal Government has to take steps, which they have started with NOSDRA, NDDC, UNEP, UN SPDC and NGOs. Improvement have begun in terms of achieving sustainable development in the Niger Delta, the government should continue to allocate more revenue into the Niger Delta for steps toward finding a permanent and lasting solution.

RECOMMENDATIONS

- Updating and revising the legislations, reviewing the license of the oil companies and reviewing the fines will go a long way in ensuring compliance, even though the government cannot systematically or frequently monitor these sites.

- Adoption of environmental friendly technology that will minimize impacts of petroleum development on the environment; gas flaring, the gas can be converted to alcohol for diverse uses or used as an alternative energy source.

- Environmental restoration by government and oil companies should be made paramount.

- Development of environmental management and research institutions should be instituted.

- Periodic Environment Impact Statement (EIS) and Environmental Impact Assessment (EIA) should help in tackling some of the environmental problems in the Niger Delta region.

- Public awareness and education by some of the oil companies will go a long a way in enhancing the information desk as a check to some effects in the region.

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