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The Niger Delta, a region of Environmental Hazards and Deteriorating Environmental Quality.

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Abstract:
The Niger Delta has witnessed a gradual but very intense deterioration in the quality of her biogeophysical environment since the commencement of the exploration and exploitation of oil and gas resources in the region for about seven decades. It is estimated that Nigeria flares about 70 million tonnes of gas daily, which is 19.7% of the global total; releasing tens of millions of tonnes of volatile organic compounds, oxides of carbon, sulphur and nitrogen into the environment. Oil spills are increasingly becoming the most common environmental hazard that undermines the region's environmental quality. About 13 million *ca* bbls of crude oil have been spilled into the Niger Delta environment, during the past 65+ years which have destroyed vast mangrove biomes, contaminated surface and groundwater and introduced carcinogens into the food chain. Rising radiological pollution is another very worrisome trend being observed in the Niger Delta. Radiation levels of up to 0.016 mRh^{-1}, about 45% higher than the normal background level in the environment; while alpha and beta activities of up to 16.95 Bq/l and 135.88 Bq/l respectively have been recorded in surface waters. Other environmental hazards include coastal and riverbank erosion, nypa palm and water hyacinth invasion, inefficient waste management practices, flooding, et cetera, that plague the region. All these environmental hazards acting in collusion have affected not only the livelihood of the people, but have also compromised their health and wellbeing.
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1.0 Introduction

The Niger Delta region is presently on a downward spiral in environmental quality. Her fragile ecosystem is incessantly mauled, oiled and despoiled. Almost every day there are reports of environmental hazards occurring in some part of the delta. Oil spillages and gas leaks, groundwater/surface water pollution, air pollution, gas flares and acid rain, climate change impacts, rising sea level and ocean surge, land subsidence, domestic and municipal waste management problems, waste oil and industrial effluent discharge and high radiological index of rivers are some of the hazards. Also observed are, increasing cancer cases, infertility, miscarriages and birth defects, destruction of mangrove forests and other wild habitats, land degradation manifesting as coastal and river bank erosion and flooding. The decline and extinction of thousands of animal and plant species, depletion of fish stock within rivers, dwindling crop yields, nypa palm and water hyacinth invasion, etc are the resultant manifestations of an over stressed and depressed environment. Thus, the devastation of the Niger Delta ecosystem is of such magnitude that qualifies the region as an ecological disaster.

The delta covers 20,000 km² within wetlands of 70,000 km² formed primarily by sediment deposition and drained by an anastomosing network of rivers and distributaries of the Niger-Benue River system. This flood plain which constitutes about 7.5% of Nigeria's total landmass, is home to over 41 million people and more than 40 ethnic groups with a population density of 265 person per kilometer square; making it one of the most densely populated regions in West Africa. It is the largest wetland in Africa and the second largest in the world. The delta's environment is constituted into four ecological zones: coastal barrier islands, mangrove swamp forests, freshwater swamps, and lowland rainforests (Dupont, et al.; 2000, Chinotu, et al., 2019).This incredibly well-endowed ecosystem contains one of the highest concentrations of biodiversity on the planet, in addition to supporting abundant flora and fauna, arable terrain that can sustain a wide variety of crops, lumber or agricultural trees, and more species of freshwater fish than any ecosystem in West Africa.

The Bayelsa State Oil and Environmental Commission report, An Environmental Genocide: Counting the Human and Environmental Cost of Oil in Bayelsa State (2023) and the United Nations Environment Programme report on the Environmental Assessment of Ogoniland (2011) bring into a very sharp focus, the types and

concentrations of contaminants within the Niger Delta environment. These contaminants of concern found particularly within the soil, groundwater and surface water resources pose serious risks to the health and wellbeing of the people and also the ecosystem (BSOEC, 2023; Giadom & Nwibubasa, 2019; Giadom & Tse, 2015). Communities in different parts of the Niger Delta are especially at risk because of inadequate knowledge, lack of appropriate regulation and enforcement by government agencies and regulators in the industry. Sadly, people often have little capacity to protect themselves and their voices are not heard in political discussions. It is a well-known fact that economic development is clearly essential for communities' livelihoods and the wellbeing of nations; but this is often a source of harmful environmental pollution as occasioned by the oil industry in the Niger Delta. The ultimate despoliation of the environment is the price that the people of the Niger Delta pay for the sustenance of the national economy. Crude oil that is spilled without ceasing into the Niger Delta environment contains many highly toxic constituents that can damage every system in the body; they could be carcinogenic, mutagenic or teratogenic (Varjani, Gnansounou & Pandey, 2017; Giadom & Nwibubasa, 2019.). Benzene a known carcinogen has been found in ground waters in the Niger Delta in concentrations 900 times above the maximum contaminant level permissible (UNEP, 2011). Benzene causes leukaemia; and other harmful effects include damage to the lungs, liver, kidney, immune system depression, infertility, hormonal imbalances, mutations, neurological disorders, birth defects, etc. Oil pollution also contaminates the food chain and undermines the capacity of the ecosystem to absorb wastes and provide the essentials for life (McHale, et al., 2011; Rinsky, et al., 2002; Giadom, 2021; Nwilo & Badejo, 2005).

Environmental degradation threatens wealth, health, amenity and ultimately threatens the survival of life on the delta. Increasing levels of poverty, ignorance and disease are direct results of environmental degradation. The productivity of the land and water resources has been greatly impaired due to environmental degradation. There have been significant reductions in fish stocks and species diversity. Agricultural productivity has also been affected as the productivity of a wide variety of crops are declining due to the oil pollution. A large segment of the population subsists directly on the land and the ever-dwindling productivity of the land has resulted to a general malaise and hopelessness in the region. This has introduced stress into the system, causing the ultimate disturbance of social harmony with its attendant misunderstandings amongst people. Hence, there arose politics of suspicion and acrimony, highly irritable society, various forms of violence and a general degradation of the mores of our society (Giadom, 2021; Omeje, 2006; Adinna, 2001).

2.0 The State of the Environment.

Discussing the state of the Niger Delta environment encompasses a clear evaluation of definition of the concept of the environment. The environment has varied definitions. However, in the following discourse, we shall consider it as the natural surroundings of an organism which directly or indirectly influence the growth and development of the organism. Figure 1 below explains the various components that make up the environment.

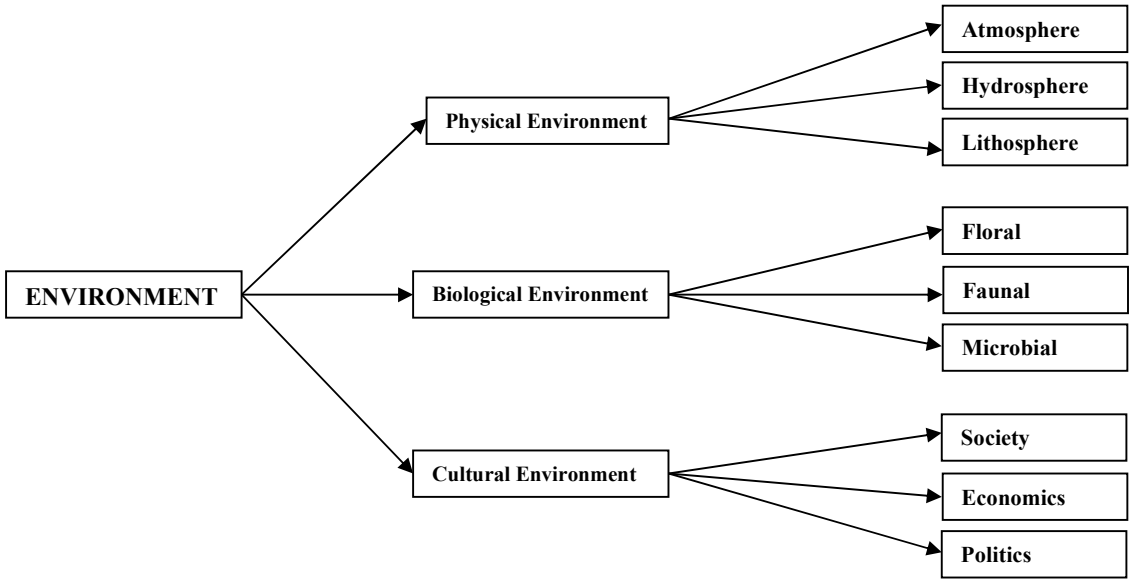

Figure 1: Chart defines a holistic concept of the Environment.

2.1 The impacts of industrial activities on the Niger Delta Environment.

Exploration and Production (E&P) operations in the oil industry worldwide, have potentials to negatively impact human health and the natural environment especially the hydrocarbon contamination of soil and groundwater resources. The Niger Delta is undeniably one of the most widely reported deltas regarding adverse environmental impact and social conflicts of oil and gas exploitation. Despite the economic importance of the Niger Delta to the nation, the region is characterized by high level of under-development, poor socio-economic infrastructures, high level of poverty and youth unemployment, widespread hydrocarbon contamination of soil, land and water resources, vulnerability to flooding and recurrent social unrest mostly related to the petroleum industry operations. The region is prone to flooding as well as adverse climate change impacts. For example, a sea level rise of one metre could lead to submergence of up 50% of the Niger Delta. The key environmental issues in the Niger Delta are summarized in the table below.

Table 1 Key environmental Issues in the Niger Delta

Key Environmental Issues	Primary causes	Development /Management challenges
• Hydrocarbon pollution of water and soil resources • Toxic and trace metal pollution • Radiation pollution of rivers and bottom sediments • Sewage and industrial effluent • Gas flaring and air emissions • Floods • Mangrove and forest degradation • Water hyacinth & Nypa palm invasion • Social conflicts and poverty • Sea level rise	• Exploration of oil and gas • Artisanal oil refining • Urban encroachment of wetlands and reclamation • Unsustainable management of natural resources • Climate change	• No functional, well-coordinated integrated strategic plan with strong community participation • Poor funding and lack of prudent management of funds • Lack of synergy between the interventionist agencies/bodies

It is important to note that the challenges of the Niger Delta are inextricably linked and focusing separately on each problem is equivalent to addressing part of the problem – the lack of *sustainable management of the Niger Delta.*

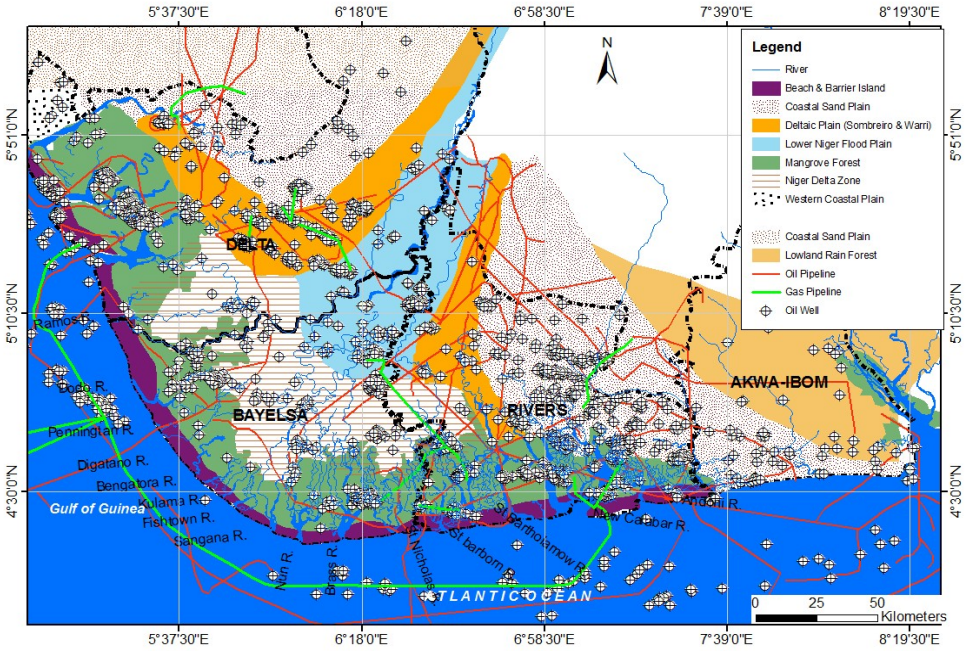

Fig. 2. Oil and gas infrastructure within the ecological zones of the Niger Delta**.**
Source: http//www.ela.doe.gov/emeu/cabs/Nigeria/).

2.2 Air Quality in the Niger Delta.

Air, a non-visible form of matter is one of the most important of earth's resources without which life cannot exist on the planet. It is however, a sink into which gaseous and particulate matter from anthropogenic and other natural sources are released. Air becomes polluted when it carries gaseous and particulate matter at levels at which they become objectionable; capable of causing discomfort or harm to man or his amenities. The quality of air in the Niger Delta has been studied by various scholars, who rank the region's air quality amongst the top 10 most polluted in the world (Oyegun, 2016; Kuenzer, et al, 2014; Sokari, 2016, UNDP, 2004, Oyekunle, 1999).

Aerosols and dry deposition are increasingly becoming hazards of air pollution in the Niger Delta. In recent times, cases of dry deposition contamination have been reported in parts of Port Harcourt and environs at unusual levels, causing discomfort and aesthetic concerns; as amenities left unattended for a few days are often coated in thick soot. These particulates are most often acidic, and not only alter the pH of soils and water bodies but also cause rapid deterioration of physical amenities, such as the corrosion of roofing sheets, other metallic structures and even cars (Giadom, 2019). They constitute health hazards to humans when inhaled, causing respiratory ailments. Tawari and Abowei (2012) observed that the operations of the oil industry as well as biomass combustion and traffic emissions releases a barrage of substances like volatile organic compounds, oxides of carbon, nitrogen, sulphur, heavy metals, particulate matter and other toxins at levels that most times exceed national and international limits.

Plate1 (a & b): Air pollution sources in the Niger Delta Source (Oyekunle, 1999)

2.2.1 IMPACT OF GAS FLARING IN THE NIGER DELTA

Nigeria flares over 70 million cubic metres of gas daily from its flare stacks, amounting to about 70 million tonnes of carbon dioxide into the environment per day and has thus contributed more greenhouse gas emissions than all other sources in sub-Saharan Africa combined. Similarly, the gas industry statistics publisher, *Cedigaz*, indicates that Nigeria accounted for 19.79% of global gas flaring in 2001, more than Iran and Indonesia combined, making Nigeria the highest gas flaring country in the World (UNDP, 2004). Kuenzer *et al* (2014), using the detection of hot spots in land-sat band data put the number of gas flares in the Niger Delta at 167 with a large proportion of them situated within the sensitive mangrove ecosystem of the Niger Delta. Black soot associated with gas flares cover vegetation and other land-use adjoining gas flare points.

Plate 2 & Fig. 3. Gas flare in the Niger Delta and NASA Satellite Imagery of the Delta at night showing gas flares. Source: *Curse of the Black Gold: 50 Years of Oil in the Niger Delta*

Gas flares release greenhouse gases of carbon dioxide (CO_2), methane (NH_4), and nitrous oxide (N_2O) which contribute significantly to global warming. The heat energy emanating from gas flares in the Niger Delta attains a temperature of $1{,}100^0$C which is high enough to damage the growth of vegetation and animal life. It destroys mangrove swamps and salt marshes, and suppresses the growth and flowering of some plants while inducing soil degradation and diminishing agricultural productivity with the attendant biodiversity loss (Emoyan et al, 2008; Mba, 2006; UNDP 2006). Furthermore, the high concentration of volatile oxides of carbon, nitrogen and sulphur released into the air mix with rain water to form acid rain and ultimately increases the acidity of the soils which is deleterious to crops. Uyigue and Agho (2007) have posited that the incidence of acid rain is higher in the Niger Delta in comparison with areas further afield.

The effects of gas flaring on the growth of cassava (*Manihot esculenta*), waterleaf (*Talinum triangulare*) and pepper (*Caspicum annuum*) – crops which are commonly cultivated in the Niger Delta manifested in decreased dimensions of leaf lengths and widths of cassava and pepper within the locality of the flare point, ultimately causing retardation in plant development. This affects cassava yields as well as starch and ascorbic acid levels in the cassava (Dung *et al* 2008). Farmers in many parts of the Niger Delta have reported a steady decline in the production of cocoyam (*Colocasia esculenta & Xanthosoma spp)* in particular as well as other staple crops. It was observed that farmlands contiguous to sources of volatile organic compounds and petroleum hydrocarbon aerosols emanating from combustion processes performed worse. Furthermore, birds or moths being attracted to and falling into gas flares are easily visible to the careful observer. What may not be so easily obvious sometimes even to a careful observer is the effect of gas flares on photoperiodic index of certain biota; which could lead to the extinction of some plants and animals (Sokari 2016). In the case of plants, for example, growth, seed germination, flowering and fruiting are affected by day length. Sadly still, Niger Delta communities have been exposed to this "continuous daylight" for over half a century.

2.2.2 Health Hazards associated with Gas Flares and burning Crude Oil

Ndubisi & Asia (2007) stated that gas flares cause respiratory disorders in man leading to kidney and neurological disorders. Poisonous chemicals associated with gas flares include nitrogen dioxide (NO_2), sulphur dioxide (SO_2), volatile organic compounds (VOC) like benzene, toluene, xylene and hydrogen sulphide. Others are carcinogens like benzapyrene, and dioxins. These chemicals intensify asthma, cause chronic bronchitis and pain. Benzene is well known as a cause of leukaemia and other diseases of the blood system.

Plate 3: Noxious fumes emanating from the burning of crude oil along a breached pipeline. Source: UNEP, 2011.

3.0 Oil Pollution and Gas Leaks, an ubiquitous hazard in the Niger Delta.

'We witnessed the slow poisoning of the waters of this country and the destruction of vegetation and agricultural land by oil spills which occur during petroleum operations. But since the inception of the oil industry in Nigeria, more than twenty-five years ago, there has been no concerned and effective effort on the part of the government, let alone the oil operators, to control environmental problems associated with the industry' (NNPC Report 1983, in Nigeria Oil and Gas Exploration and Regulations Handbook. P73*).* The foregoing report, issued over 40 years ago by a government agency highlighted the problem of oil pollution in the Niger Delta, long before the insurgence of contemporary violence and instability in the region. As always, this was an unheeded clarion call. The operations of the oil industry have been carried out with an unconscionable recklessness that have turned ecological sanctuaries of the region into wastelands. Nowhere in the world can we find conditions akin to what obtains in the present-day Niger Delta.

Plate 4: Oil spill scenes in the Niger Delta. Source: Stakeholder Democracy Network (SDN)

Oil spills routinely occur in the Niger Delta from various sources. They include, pipeline leakage and rupturing, accidental discharges (tank accident) discharges from refineries, equipment failures, sabotage, oil well blowouts, oil blast discharges, improper discharge of drilling mud. All these have seriously degraded the Niger Delta environment which has led to: (i) The loss of the aesthetic values of natural beaches, due to unsightly oil sleeks, (ii) damages to marine wild life, modification of the ecosystem through species elimination and the delay in Biota (faunal and floral) succession and (iii) decrease in fishing resources (Isirimah et al, 2004; Oyegun, 2016).

Gas leaks are also widely reported in the region as several communities are exposed to fugitive emissions and gas leaks form the oil and gas industry facilities. The magnitude of this hazard in one of those incidents in 2012, in Egi clan, Rivers State was so intense that the natives were advised to refrain from lighting lanterns or making fires to cook for fear of causing fire explosion in the area. Again, in November 2021, another horrifying gas explosion occurred in the Santa Barbara Well 1, Nembe, Bayelsa State; and went on unabated for 39 days, before the well could be 'killed'.

Plate 5: Gas leak from a well, arrowed in the foreground of this photo. Source: SDN (2023)

An estimated, staggering volume of 9-13 *ca* million barrels of crude oil have been spilled into the Niger Delta environment since 1958, in over 6500 spill incidents; averaging to about 150 spills annually (Baird, 2010; Kadafa, 2012). In the classic case of the Exxon Valdez oil spill of 1989, only about 240,000 barrels of oil was spilled. The Gulf of Mexico spill in 2010 have attracted so much attention on the hazards of oil pollution to the

marine environment. It is sad to state here that the magnitude of oil pollution taking place in the Niger Delta by far dwarfs most of these incidents in frequency and magnitude; yet it has not drawn the level of attention it truly deserves from both the national and international communities.

3.1 Ageing Pipeline Infrastructure and Oil Spills:

The Trans-Niger Pipeline (TNP), commissioned in 1961 has being in operation for over 50 years evacuating 180,000 bbls *ca* of crude oil per day through the Bodo Creek to the Bonny Oil Terminal. SGS Inspection Services Nigeria Ltd, undertook an integrity assessment of the TNP and recommended the replacement of this pipeline in a report released in 2000; but as usual no action was taken until disaster struck 8 years later (Giadom & Nwibubasa, 2019).

In August and December 2008, two operational spills occurred along the Trans-Niger Pipeline in Bodo. These spills were left unattended for over five weeks in each of the separate cases. It was estimated that a total of 560,000 bbls of oil was spilled, which had a devastating impact on the Bodo Community (BSOEC, 2024). This oil spill led to the devastation of over 2,000 ha of mangrove forests within the Bodo estuary. The magnitude of despoliation of the mangrove forests, due to oil spills in Bodo has been described as the highest devastation of the mangrove ecosystem anywhere in the tropics (Gundlach, 2013).

Many of the spills reflect a failure to properly invest in, maintain, manage and protect pipelines and facilities to minimise the risk of spills. The rate at which oil pipelines and facilities develop leaks in Nigeria is unparalleled when compared to other major oil producing countries. Analyses suggest that Nigeria's pipelines are 565 times more likely to spring a leak per kilometre than those in the EU (Steiner, 2010). International standards for inspection, repair and corrosion-proofing of pipelines do not appear to be observed. Much of the oil infrastructure is nearing the end of its operational life. A study conducted on pipelines in six states in the Niger Delta found that more than 70% of the pipelines were over 20 years old and over 40% were more than 30 years old with much of the infrastructure suffering from mechanical failures due to poor construction and maintenance (Achebe, et al., 2012).

Plate 6:(a) Aged and corroded Pipeline & (b) An imagery of the area (2000 ha *ca*) of destroyed mangrove forest delineated in red in Bodo. Sources: (a) Bayelsa State Oil & Environmental Commission & (b): Gundlach, E.

3.2 The Vulnerability of the Niger Delta Aquifers to Oil Pollution

The geology of the region comprises of recent unconsolidated sediments which enhances the ease of contaminant migration in the subsurface. This underscores the vulnerability of the aquifers to petroleum hydrocarbon contamination. The Benin Formation (coastal plain sands) is the main regional aquifer, consisting of over 60% sands, with regional transmissivity values: 1.05×10^{-2} *to* 11.3×10^{-2} m^2/sec (Amajor, 1991). Natural Gradient Tracer Tests carried out in the region reveals average groundwater velocity of $1.403 \times 10^{-3} ms^{-1}$ (Giadom, et al; 2015). These values further show that the aquifers in the Niger Delta region have very high potentials for contaminant transport.

The water table in most parts of the Niger Delta is very shallow with an average range that varies between 2m to 6m, especially in the wet season which exists for over 8 months of the year. Thus, it becomes very easy that once oil is spilled, it finds its way to groundwater resulting to a contaminant plume that travels predominantly in the direction of groundwater flow. Heavy Hydrocarbon contamination has been encountered at depths exceeding 5m below ground surface (UNEP, 2011). This particular scenario makes Remediation/cleanup very challenging.

3.3 The Hazards of Crude oil Spills in the Niger Delta Environment:

Studies have shown that the widespread presence of petroleum hydrocarbon contaminants in the bio-physical environment of Niger delta is capable of exerting acute and long-term adverse health and environmental effects. Crude oil spills besides reducing soil fertility and smothering economic trees and food crops, out rightly kills them or reduces their yield and protein content. This causes food insecurity and deterioration of the quality of the staple food, leading to an increase in the prevalence of childhood malnutrition in the region. Also observed is the bio-accumulation of heavy metals such as lead and cadmium in the surviving food crops like cassava and pumpkin (Osuji & Nwoye, 2007; Ordinioha & Sawyer, 2008). Periwinkle *Tympanotonus fuscatus var. radula* (a local delicacy in the Niger Delta) from Elechi and Bodo Creeks, Niger Delta, were observed to have accumulated and concentrated more of these heavy metals than the sediments and water column in their environments (Sikoki & Babatunde, 2016).

The persistence of spilled crude oil in the region could result not only in infertility, but also hemotoxicity, hepatotoxicity,and carcinogenesis through its effects on chromatin DNA. Other hazards include significant increases in the period prevalence for diarrhoea, sore eyes, itchy skin and occupational injuries. Shock, acute renal failure, extensive epidermolysis, conjunctivitis, mucositis, esophagitis, and chemical pneumonitis were reported in a 2-year-old treated for febrile convulsion. Known carcinogens like benzo-(a)-pyrene and polycyclic aromatic hydrocarbons (PAH) found in surface waters and soils in the region do not have any safe levels, as even a few molecules of these can be genotoxic. The difference in the concentration of PAH in the ambient air was also given as a reason for the higher prevalence of certain types of cancers seen in Port Harcourt compared with Ibadan (Otaigbe & Adesina, 2005; Eyong, et al; 2004, Sunmonu & Oloyede, 2007, Ana, et al, 2010; Oruambo & Peter-Omoghia, 2012).

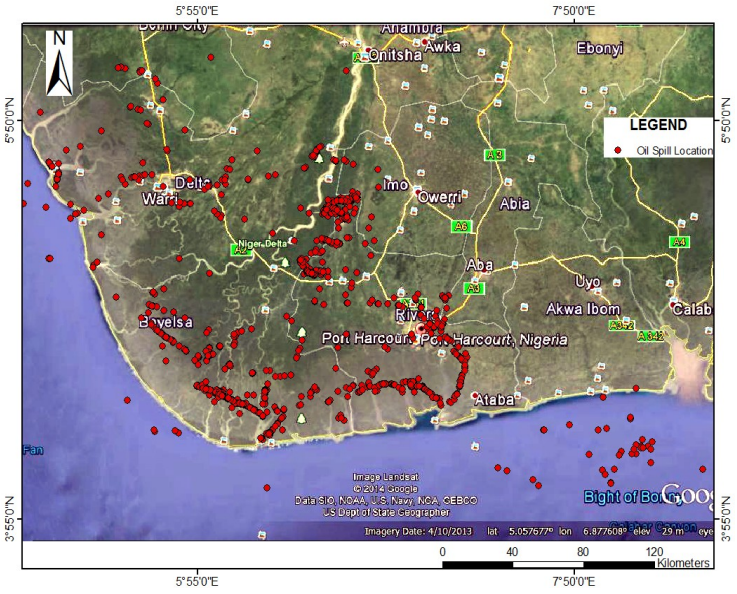

Figure 3: Recent oil spill sites (red dots). Source: Nigerian Oil Spill Monitor.

3.4 Artisanal Crude Oil Refining… Turning 'ecosanctuaries' into Wastelands

The process of artisanal refining typically involves 'low-tech' metal pipes and drums welded together in which crude oil is boiled and the resultant fumes are collected, cooled and condensed in tanks to be used locally for lighting, energy or transport. The distilleries are heated on open fires fed by crude oil that is tipped into pits in the ground. As part of the oil burns away, some seeps into the ground. A typical artisanal refinery may comprise just one operating 'boiling drum' and the entire refinery may be no more than 100 square metres in area, located at the edge of a river to facilitate the evacuation of the products (UNEP 2011).

Balogun (2015), using remote sensing techniques have mapped and estimated area of 37.6km^2 of mangrove forests undergoing severe stress and damage and another 9.2km^2 of water ways impacted by the hazards of artisanal crude oil refining in parts of Rivers State. Note that Mangroves are important for the carbon balance of the coastal zone (Boullion, et al, 2008; Kristensen, et al, 2008). According to Kuenzer (2011) mangrove ecosystems provide various ecological and economic ecosystem services contributing to coastal erosion protection, water filtration, provision of areas for fish and shrimp breeding, provision of building material and medicinal ingredients, and the attraction of tourists, amongst many other benefits. The effects of oil spills on mangroves are known to acidify the soils, halt cellular respiration asphyxiate mangrove pneumatophores by starving them of vital oxygen and then kill them ultimately.

Plate 7: Artisanal Refinery (Source: Stakeholder Democracy Network, SDN)

The footprints of individual artisanal refineries may be local, however, cumulatively it has exacted a large toll on the region. The Bodo Community in Ogoniland as a typical case have lost 307, 381m^2, which is 10% of mangrove forest within four years, 2007-2011 (UNEP, 2011). Furthermore, according to Lewis (1983) mangrove forest complete recovery period from oil spill impacts takes 10 to 50 years; and the recovery is predicated on a number of factors, which includes: type of crude and volume spilled, geomorphology of the spill site, tidal dynamics, mangrove species, etc. The import of this is that some of the impacted mangrove ecosystems might never recover to full functionality (Giadom and Dumpe, 2004). There are hundreds of artisanal refineries dotted all over the Niger Delta; hence the cumulative destruction of mangrove habitats within the past decade is mind boggling.

The environmental hazards posed by these refineries include:

- Destruction of large swaths of the mangrove forest
- Contamination of soil and groundwater
- Damage to surrounding vegetation with smoke and fire
- Air pollution to surrounding communities, as hapless citizens have to inhale dioxins, Polynuclear Aromatic Hydrocarbons, VOCs and other dangerous carcinogens
- Fire hazards leading to severe burns and death of artisans
- Contamination of coastal ecosystems as tidal waters carry refinery wastes to wider areas.

3.5 Radiological Pollution in the Niger Delta

The crude oil of the region contains some naturally occurring radioactive materials (NORM); the decay series of naturally occurring radionuclides headed by (238) U and (232) Th have mean activity concentrations of 0.80 ± 0.37 Bq/kg and 0.17 ± 0.09 Bq/kg, respectively, in the crude oil blends, while the mean concentration of the non-decay series radionuclide, (40) K is 10.52 ± 0.03 Bq/kg. The radiation level within oil spill sites is often up to 0.016 mRh^{-1}, about 45% higher than the normal background level of 0.011 mRh^{-1} in the Niger delta communities, and the concentrations of the NORM in surface water are often higher than the WHO recommended maximum permissible limit for drinking water. A study of the Imiringi oil field in Bayelsa State and the Bonny River estuary recorded an alpha activity of up to 16.95 Bq/l and a beta activity of up to 135.88 Bq/l. (Sikoki & Babatunde, 2016; Ajayi, et al, 2009; Agbalagba & Meindinyo, 2010).

4.0 Coastal and Inland River Erosion:

The coastline of the Niger Delta, measuring up to 500km ca is for most part made up of beaches of beach-ridge barrier islands, except for the transgressive Mahin mud coast in Ondo state. These coastal environments are constantly experiencing wave action which causes erosion. The following average annual erosion rates have been reported by Ibe (1988):

- Awoye/ Molume (Ondo State) 20-30m/year
- Ogborodo/Escravos (Delta State) 18-24m/year
- Forcados (Delta State 20-22m/year
- Brass (Bayelsa State) 16-19m/year
- Ibeno-Eket (Akwa Ibom State) 10-13m/year

These annual rates of erosion raise serious concerns because it uproots coastal settlements, decimates agricultural and recreational grounds and poses serious hazards and economic loss. Furthermore, inland river erosion has also been observed, occasioned by unregulated sand mining in these inland rivers which triggers bank failure and initiates gully development. This land degradation within the riparian corridor, affects agriculture, lowers water table, increases river turbidity and leads to biodiversity loss (Giadom & Akpokodje, 2016).

4.1. Fluvial Flooding in the Niger Delta, 2012 Floods: A Signal of Things to Come

The Nigeria flood of 2012 has been described as the most severe and devastating in the history of modern Nigeria. The Niger Delta region suffered the most extensive devastation because of its location in the lowest part of Nigeria where the Niger and Benue rivers empty their waters into the Atlantic Ocean. Flood heights attained maximum of 3.68m at several floodplain observation stations within the Niger Delta whilst those taken at the centres of major rivers range between 6.46m to 7.88m above the normal seasonal water levels. Most parts of Niger Delta were inundated for 6-8 weeks causing severe negative impact to flora and fauna. Chemical wastes from oil industry disposal sites were carried by the flood waters which contaminated surface and groundwater

resources within communities. People were exposed to hazardous wastes and this was compounded by social pressures arising from displacement and migration (Akpokodje & Giadom, 2014).

4.2 Nypa Palm and Water Hyacinth Invasion.

Nypa fruticans, commonly known as the nypa palm, is a species of palm native to the coastlines and estuarine habitats of the Indian and Pacific Oceans. It is the only palm considered adapted to the mangrove biome. Although Nypa is non-native to Nigeria, having been introduced into the country in 1906 from Singapore, it has become the determinant of succession sequence in estuaries of the Niger Delta. Primary succession occurs when nypa seedlings invade and establish on mudflats that have never before been habited by mangrove. Nypa saplings, being more vigorous in growth than mangrove propagules, eventually dominate the secondary succession and take over the former mangrove habitat. They seem to succeed, quite easily in biomes where mangrove species, such as *Rhizophora mangle* and *Rhizophora avicennia, etc* are experiencing stress either from fluctuating water salinities, to oil spills or even human interferences, such as lumbering and fuel wood harvesting.

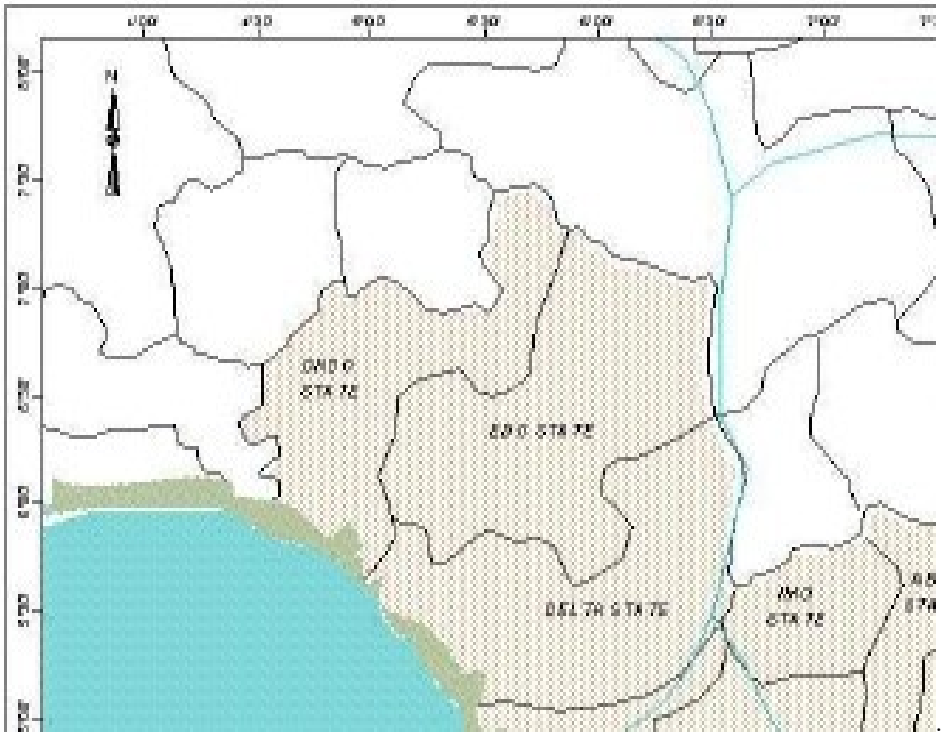

Figure 4: A map of the Niger Delta, showing areas of Nypa Palm invasion. Source: Ukpong, 2002.

The Nypa palm is considered as a nuisance in the Niger Delta; as it is a destroyer of the mangrove ecosystem; with an attendant negative effect on aquatic life (Ukpong, 2002). It does not create a conducive ground for spawning and breeding of fishes; leading to the migration of fishes away from nypa palm colonies and a resultant decrease in catch for local fisherfolks.

Plate 7: A Nypa palm colony along the Imo River. Source: Ukpong, 2002.

4.3 Problems of Water Hyacinth (*eichhornia crassipes*) in the Niger Delta

The numerous rivers, creeks and creek-lets crisscrossing the Niger Delta constitute very important water transportation routes, fishing and recreational grounds, as well as the source of potable water, for local inhabitants. However, most of these fresh and brackish-water systems have been invaded by water hyacinth (Plate 8), rendering the waterways impassable for domestic, communal and Exploration and Production activities. The areas are inaccessible for fishing activities, which is the traditional occupation and the sources of livelihood for peoples of the Niger Delta. Studies revealed that the water hyacinth entered Nigeria about 1984 from the neighbouring Republic of Benin (Akinyemiju, 1987, Egborge, 1993). Within ten years of its arrival in Nigeria, the weed covered a distance of 700km of Nigeria coastal waters from Badagry to Port Harcourt and as far north as Asaba/Onitsha along the River Niger.

Plate 8: (a) Water hyacinth along River Niger (b) LASWA clearing water hyacinth in Lagos

5.0 Conclusion

The environment is the totality of our natural surroundings, without which life cannot exist in the forms we know it. The growth and development of any living form is directly influenced by the environment whose provisions sustain and nourish all things within its sphere. Therefore, the overall wellbeing of Niger Delta communities is exclusively dependent on the full functionality of all components of her environment.

However, the environment can only be fully functional, when it is maintained within a narrow range of physical conditions. Thus, when the baseline conditions are altered, as it is with the ubiquitous pollution in the delta, its ability to provide the basic ecosystem services will be undermined. Hence, there will be very little prospects of actualising healthy, meaningful and purposive existence for the people.

The communities in the Niger Delta bear the brunt of environmental degradation wrought largely by the oil and gas industry. It is obvious that the quality of the environment is on a steady decline, and only a conscious effort of government and civil organisations can reverse this decline. Local communities must also rise to the defence and protection of their heritage, the environment. This, can be achieved through environmental action, demanding responsible and sustainable exploitation of natural resources and the conscientious implementation of regulatory frameworks that protect and safeguard the environment for future generations and thus fulfilling the tenets of SDG12.

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