Bulletin of Pure and Applied Sciences.
Vol.39F, Geology (Geological Science), No.2,
July-December 2020: P.102-114
Original Article

Print version ISSN 0970 4639
Online version ISSN 2320 3234
DOI: 10.5958/2320-3234.2020.00011.6
Available online at www.bpasjournals.com

The Quandary on Water Pollution in Nigeria's Niger Delta: an Environmental Ethical Analysis

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(Received on 06.03.2020, **Accepted on 25.07.2020**)

ABSTRACT

The Niger Delta region has suffered environmental degradation since the discovery of oil in the region. Oil exploration in the region has not been of much benefit to the local communities. It has rather been a source of agony and anguish for them. Farmlands which were hitherto fertile for sufficient food production and bumper yields for the populace have become highly infertile due to oil spills and gas flares. Creeks and rivers that used to serve as their main channel of getting protein diets through fish and other sea foods have all become covered with oil films causing accelerated extermination of aquatic lives. This paper sets out to explore the activities of oil exploration in the Niger Delta, the problem of water pollution caused by oil as well as the impacts on their environment and its people. It proposes that both the oil companies and indigent citizens should be environmental ethically concerned. We also argue for the enactment of adequate laws and legislations that could govern oil exploration and exploitation in Nigeria, and then examine a few ways that environmental degradation in the Niger Delta can be solved. The approach used is the expository and contextual analytical methods.

KEYWORDS: *Environment, Socioeconomic life, Oil and Gas Exploration and Production, Niger Delta, Pollution.*

INTRODUCTION

Globally, about 9 billion people still remain without access to improved sources of water. Similarly, about 2.6 billion have no access to any form of improved sanitation services (WHO/ UNICEF, 2010). The majority of these persons are in Asia (20%) and sub-Saharan Africa (42%) (WHO; UNICEF, 2000). Consequently, people in developing countries especially children below five years die every year from diseases associated with lack of access to safe drinking-water, inadequate sanitation and poor hygiene (WHO 2000). Urban water supply coverage is only 70% of the total water requirements in the urban areas of Nigeria. Out of the 70% only 40% can boast of regular water supply (CWSD, 1999). The use of groundwater as the main source of potable water supply is increasing worldwide and in Nigeria, 62-71% of people in semi-urban and rural communities rely on groundwater (Obiri- Danso et al., 2009) as their main source of drinking water. However, in many developing countries, groundwater sources have been contaminated as a result of the indiscriminate dumping of untreated industrial wastes into receiving waters which eventually pollute water supplies (World Water Day, 2010). Secondly, there is direct contamination of surface waters with metals in discharges from

mining, smelting, leachate from municipal wastes, hazardous E-waste, agrochemicals, accidental oil spillages and industrial manufacturing (Asamoah-Boateng, 2009; Adetunji and Odetokun, 2011).

Poor water supply and inadequate sanitation results in diarrhoeal diseases such as cholera, dysentery and chronic and long term ill effects due to heavy metal poisoning and accumulation. Heavy metal poisoning is evident in Bangladesh, where 20% of its well water naturally contains high levels of arsenic (WHO / UNICEF, 2000). The incidence of high fluoride and arsenic in groundwater of Karbi Angling and Nagaon district of Assam, India and its manifestation in the form of fluorosis has also been reported (Sabhapandit et al., 2010). Industrial waste has been a problem since the industrial revolution. Industrial waste may be toxic, ignitable, corrosive or reactive. If improperly managed, this waste can pose dangerous health and environmental consequences. The essence of this study is to explore the problem of water pollution caused by oil that has bedeviled the Niger Delta region and the impacts on their environment and its people. It shall also discuss the need for adequate laws and legislations that could govern oil exploration and exploitation in Nigeria, as well as examine ways environmental degradation in the Niger Delta could be addressed.

Water is one of the essentials that support all forms of plant and animal life (Vanloon and Duffy, 2005) and it is generally obtained from two principal natural sources; surface water such as freshwater lakes, rivers, streams, etc. and Groundwater such as borehole water and well water (McMurray and Fay, 2004; Mendie, 2005). Water has unique chemical properties due to its polarity and hydrogen bonds which means it can dissolve, absorb, adsorb or suspend many different compounds (WHO, 2007), thus, in nature, water is not pure as it acquires contaminants from its surrounding and those arising from humans and animals as well as other biological activities (Mendie, 2005).

Groundwater is underground or subsurface water. Groundwater comes from surface water percolating through overlying soils and it resides in the pore spaces between particles of soil and other geological materials. Formations that have all the pore spaced saturated with water are called saturated zones or aquifers. The top of the aquifer is called the water table. Aquifers typically consist of gravel, sand, sandstone, or fractured rock, like limestone. These materials are permeable because they have large connected spaces that allow water to flow through. The amount of groundwater and the speed at which groundwater flows depends on the size of the spaces in the soil or rock and how well the spaces are connected (USGS, 2009).

Groundwater is located in an underground, saturated zone but can intercept surface water. Water wells extend into aquifers to allow water to be collected and pumped to the surface. Groundwater does not (generally) exist as underground rivers or pools**-**instead it is captured between particles above an impermeable layer that restricts water movement further downward. The quality of ground water is the resultant of all the processes and reactions that act on the water from the moment it condensed in the atmosphere to the time it is discharged by a well or spring and varies from place to place and with the depth of the water table (Jain et al., 1995) With sufficient water infiltration, soil contaminants such as heavy metals can leach to underlying groundwater. Unconfined aquifers are especially vulnerable to various contaminants (Nouri et al., 2006) and sediment loads (including microscopic bacteria, viruses and protozoa).

Municipal area mostly depends on surface water for their drinking water supplies. Precipitation that does not evaporate or infiltrate into the ground runs as surface water, which may accumulate to form streams, and streams join to form rivers. Lakes are inland depressions that hold standing freshwater. Ponds are generally considered to be small temporary or permanent bodies of water shallow enough for rooted plants to grow over and at the bottom. While lakes are containing nearly one hundred times compared to rivers and streams, they are still a major component of total world water supply (Mallard, 1982). Because of the interconnectedness of groundwater and surface water, these contaminants may be shared between the two sources. Neither water source can ever be entirely free from water contaminants. Due to the cycle of water (hydrology), the two sources of drinking water feed each other, sharing contaminants.

Water pollution is the introduction into fresh or ocean waters of chemical, physical, or biological material that degrades the quality of the water and affects the organisms living in it (Israel Water Authority 2015). This process ranges from simple addition of dissolved or suspended solids to discharge of the most insidious and persistent toxic pollutants (such as pesticides, heavy metals, and non-degradable, bioaccumulative, chemical compounds). Conventional or classical pollutants are generally associated with the direct input of (mainly human) waste products. Rapid urbanization and rapid population increase have produced sewage problems because treatment facilities have not kept pace with need. Untreated and partially treated sewage from municipal wastewater systems and septic tanks in un-sewered areas contribute significant quantities of nutrients, suspended solids, dissolved solids, oil, metals (arsenic, mercury, chromium, lead, iron, and manganese), and biodegradable organic carbon to the water environment. Conventional pollutants may cause a myriad of water pollution problems. Excess suspended solids block out energy from the Sun and thus affect the carbon dioxide-oxygen conversion process, which is vital to the maintenance of the biological food chain (Howarth 2018). Also, high concentrations of suspended solids silt up rivers and navigational channels, necessitating frequent dredging. Excess dissolved solids make the water undesirable for drinking and for crop irrigation. Although essential to the aquatic habitat, nutrients such as nitrogen and phosphorus may also cause over fertilization and accelerate the natural aging process (eutrophication) of lakes (Howarth 2018). This acceleration in tum produces an overgrowth of aquatic vegetation, massive algal blooms, and an overall shift in the biologic community-from low productivity with many diverse species to high productivity with large numbers of a few species of a less desirable nature. Bacterial action oxidizes biodegradable organic carbon and consumes dissolved oxygen in the water. In extreme cases where the organic-carbon loading is high, oxygen consumption may lead to an oxygen depression: (less than 2 mg/1 compared with 5 to 7 mg/1 for a healthy stream) is sufficient to cause a fish kill and seriously to disrupt the growth of associated organisms that require oxygen to survive (UN water 2010).

The nonconventional pollutants include dissolved and particulate forms of metals, both toxic and nontoxic, and degradable and persistent organic carbon compounds discharged into water as a by-product of industry or as an integral part of marketable products. More than 13,000 oil spills of varying magnitude occur in the United States each year (Howarth, 2018). Thousands of environmentally untested chemicals are routinely discharged into waterways; an estimated 400 to 500 new compounds are marketed each year. In addition, coal strip mining releases acid wastes that despoil the surrounding waterways. Nonconventional pollutants vary from biologically inert materials such as clay and iron residues to the most toxic and insidious materials such as halogenated hydrocarbons such as DDT, Kepone, Mirex, and polychlorinated biphenyls-PCB (Bowen, 1975). The latter group may produce damage ranging from acute biological effects (complete sterilization of stretches of waterways) to chronic sublethal effects that may go undetected for years. The chronic low-level pollutants are proving to be the most difficult to correct and abate because of their ubiquitous nature and chemical stability (OECD Studies on Water 2017).

Thermal pollution is the discharge of waste heat via energy dissipation into cooling water and subsequently into nearby waterways. The major sources of thermal pollution are fossil-fuel and nuclear electric-power generating facilities and, to a lesser degree, cooling operations associated with industrial manufacturing, such as steel foundries, other primary-metal manufacturers, and chemical and petrochemical producers. The discharge temperatures from electric-power plants generally range from 5 to 11 C degrees (9 to 20 F degrees) above ambient water temperatures (OECD Studies on Water 2017). An estimated 90% of all water consumption, excluding agricultural uses, is for cooling or energy dissipation (Israel Water Authority 2015). The discharge of heated water into a waterway often causes ecologic imbalance, sometimes resulting in major fish kills near the discharge source. The increased temperature accelerates chemical-biological processes and decreases the ability ofthe water to hold dissolved oxygen. Thermal changes affect the aquatic system by limiting or changing the type of fish and aquatic biota able to grow or reproduce in the waters. Thus rapid and dramatic changes in biologic communities often occur in the vicinity of heated discharges.

Study Area

The Niger Delta with an estimated area of about 70,000km^2 is one of the World's largest deltas. It is located in the Central part of Southern Nigeria between above latitude 5° 33' 49"N and 6°'31'38"E in the North. Its Western boundary is given as Benin 5° 44' 11"N and 5° 03'49" E and its Eastern boundary is Imo River 4° 27'16"N and 7° 35'27"E. Map of the Niger delta has been depicted I Figure 1.

Figure 1: Map of the Political Niger Delta
(Source: UNDP, 2009)

The Niger Delta is located along the Atlantic coast which forms the southern boundary of Nigeria, and it is the entrance of Rivers Niger and Benue into the ocean through a web of rivers, creeks, and estuaries. It is the largest wetland in Africa and the third largest in the world, with about 2370 km^2 of rivers, creeks and estuaries. Its vegetation is predominantly of the forest type with 8600 km^{2}of swamp forest and about 1900 km^{2}of mangrove forests (Alagoa, 2005). The region situated in the southern part of Nigeria, is bordered in the east by the Republic of Cameroun and in the south, by the Atlantic Ocean. Within Nigeria, the region is defined both geographically and politically. The geographic Niger Delta includes the littoral States of Rivers, Bayelsa, Delta, Cross River and Akwa Ibom; and has an area of about 67,284 km^{2}with a combined population of 16,331,000 persons. The political Niger Delta includes the aforementioned and in addition, Abia, Edo, Imo, and Ondo states, with a total area of 112,110 km^{2}of land. The region represents about 12% of Nigeria's total surface area (NDDC, 2006).

The region has a lot of gas reserves which when sufficiently harnessed, could yield income far in excess of crude oil incomes. There are about 606 oil fields in the Niger Delta, of which 360 are on-shore and 246 are offshore (Nwilo and Badejo, 2005). Most of the new oil fields are deep water fields developed and being developed offshore. The region is dominated by the Ijaw ethnic group. Other groups in the Western Delta include; the Isoko, Itsekiri, Kwale and Urhobo. In the eastern delta are groups like the Ekpeye, Andoni, Ikwerre, Ndoni and the Ogoni. The populations of the major states are as shown in Table 1 and geographical statistics of Niger delta were depicted in table 2.

The Niger Delta region with its natural endowments of oil and gas which drives the international economy is poverty ridden as a result of political marginalization, economic pauperization and environmental degradation occasioned by its small soil and oil company activities in the region and long years of rejection by the Federal Government of Nigeria (Akpan, 2007).

Table 1: The Political Niger Delta

State	Capital	Land Area	Population
Abia	Umuahia	4,877	3,230,000
Akwa Ibom	Uyo	6806	3,343,000
Bayelsa	Yenagoa	11,007	1,710,000
Cross River	Calabar	21,930	2,736,000
Delta	Asaba	17,163	3,594,000
Edo	Benin	19,698	3,018,000
Imo	Owerri	5,165	3,342,000
Ondo	Akure	15,086	3,025,000
Rivers	Port Harcourt	10,378	4,858,000
TOTAL		112,110	28,856,000

Source: GTZ population projection based on 1991 census and NDRDMP Demography and Baseline sectors study; Agriculture and Rural development sector study Projection based on 1991 census and NDRMP

Table 2: Geographical statistics of Niger Delta

State	Capital	Land area	Population
Akwa Ibom	Uyo	6800	3, 343,00
Bayelsa	Yenogoa	11,007	1,710,000
Cross River	Calabar	21, 930	2,736,000
Delta	Asaba	17, 163	4,594,000
Rivers	Port Harcourt	10, 378	4,858,000

METHODOLOGY

This paper sets out to explore the activities of oil exploration in the Niger delta, the problem of water pollution caused by oil as well as the impacts on their environment and peoples residing in the area. For the purpose of the present work two steps studies was carried out viz. environmental degradation caused by oil exploration and environmental ethics and the solution to water pollution in the Niger delta region.

RESULTS AND DISCUSSION

Environmental degradation caused by oil exploration in the Niger delta region

Since large scale operations in the oil industry began in 1958, the Niger Delta region had been steadily experiencing cases of environmental degradation. One of the first observable cases of the environmental impact of the oil industry in the Niger Delta is related to oil spillage. Delt and IGBEN (2012) stated that increasing petroleum exploitation activities like seismic surveys, land acquisitions, drilling, transportation, storage, waste dumping and associated oil spillages have increased the degradation of the physical environment and resulted in the deprivation and destruction of economic livelihoods of the Niger Delta region. It is recorded that the first large-scale oil blow out occurred in October 1959 and rendered over 2000 people homeless. The first oil spill occurred in 1970 with over 150 barrels spilling on both land and water.

Akpan (2006:18) records between 1970 and 1983, about 1,581 cases of oil spill involving 1,711,355 barrels occurred on both offshore and onshore. Between 1976 and 1996, 4647 oil spills were recorded to have spilled approximately 2,369,470 barrels of oil into the environment. Nwilo and Badejo (2005) state that out of the quantity spilled, 77% were lost to the environment while 23.17% was recovered. By 1998, 5,724 cases involving 2,571,118 barrels were released into the environment

(Udoh et al., 2008). The National Oil Spill Detection and Response Agency (NOSDRA) reports that approximately 2,400 oil spills have been reported between 2006 and 2010. A New York Times (2012) report states that about 260,000 barrels of oil have been spilled each year for the past 50 years.

Nwankwo and Ifeadi (1988) argued that damages to the environment include the following:-

- Oil film, on water surfaces prevents natural aeration and leads to death of trapped marine organisms below the surface.
- Oil contaminates food materials which now become harmful to man, plants and animals.
- Oil on land could lead to retardation of vegetation growth for a period. It could also lead to fire out break with disastrous consequences to the environment.

The United Nations Environment Program (UNEP, 2011) report on Ogoniland, confirmed that for over 50 years, there has been wide spread oil contamination across land and water resources in the Niger Delta from oil production and that it could take 25 to 30 years to return to normalcy.

The oil spillages occur both at oil locations and along pipelines. There are about a dozen networks of pipelines that convey crude to the export and domestic refineries and fuel depots across the country. The pipelines run from 49.89km (31miles) to 616.379 km (383 miles), through mostly rural or swampy areas of land. Most of the pipelines are owned by the major International Oil Companies (IOCs) and the Nigerian National Petroleum Corporation (NNPC).Incidents of gas flaring have occurred continuously since the beginning of exploitation of oil in the Niger Delta, mostly due to the absence of the infrastructure to produce and market associated natural gas. Gas flares cause health problems resulting from excessive heating of the soil and vegetation. It also results in acid rain and soil degradation and drove away wild life from the region, as this threatens the traditional means of livelihood like hunting and farming. The continuous flaring of associated gas while exploiting oil has made Nigeria contribute immensely to global warming and depletion of the ozone layer. As the global warming worsens, it also compounds the already very bad problems of desertification in the Northern part of Nigeria. Notable Oil Spills in the Niger Delta has been depcied in table 3.

Table 3: Notable Oil Spills in the Niger Delta

Date	Incident	State	Quantity Spilled
July 1979	Forcados Terminal Oil Spill	Rivers	570,000
Jan. 1980	Funiwa No. 5 Well Blowout	Rivers	400,000
May 1980	Oyakama Oil Spill	Rivers	10,000
Nov. 1982	System 2c Pipeline Rupture	Warri-Kaduna Abudu Edo	18,000
August 1983	Oshika Oil Spill	Rivers	10,000
Jan. 1988	Idoho Oil Spill	Akwa Ibom	40,000
1988	Jones Creek	Delta	21,548
Oct. 1998	Jesse Oil Spill	Delta	10,000
May 2000	Etiama Oil Spill	Bayelsa	11,000
Dec. 2003	Agbada Oil Spill	Rivers	Unknown
August 2005	Ugheli Oil Spill	Delta	10,000
August 2004	Ewan Oil Spill	Ondo	Unknown

Source: UNDP (2006)

Oil spills occur through leaks or damage to oil pipelines or from accidents involving tankers, road trucks or railway cars. On-shore pollution occurs during loading and unloading operations of tankers.

Water produced with crude oil contains some chemicals injected to inhibit corrosion or enhance separation of oil form water (Nwankwo and Ifeadi 1998). The disposal of produced water causes environmental pollution especially in freshwater environs. Industrial wastes like mineral, metals glass and plastics and pollute where they are dumped. Refinery wastes characteristically

pollute water and air. Atmospheric contaminants include oxides of nitrogen, carbon and sulphur. Liquid refinery effluents contain oil and grease, phenol, cyanide, sulphide suspended solids, chromium and biological oxygen. Transportation and marketing operations generate oil spills and hydrocarbon emissions. Use lubrication and comprise the single greatest type of waste oil generated in Nigeria. Other waste oils emanate from tank sludge, bitumen, slops and oily sand or sediment. Waste-water containing oil may be discharged during the cleaning of ballast tanks and ships, tank trucks and tank cars. Other sources of waste include leaky valves and connections and flushing of pipelines Nwankwo (1984). The lists significant pollutants for selected sources in the oil industry as were depicted in Table 4.

Table 4: lists significant pollutants for selected sources in the oil industry

Exploration and Exploitation	Petroleum Refining	Transportation and Marketing Operations
Drilling Mud and Cuttings Oil and Grease Salinity Sulphides Turbidity Suspended Solids Temperature pH(alkalinity/acidity) Heavy metals	Oil and Grease BoDs CNDs Phenol Cyanide Sulphide Suspended Solids Total Dissolved Solids Temperature Chromium pH (acidity/alkalinity)	Oil and Grease BoDs CNDs Toxic Additives and Materials Hydrocarbons Total Suspended Solids

Source: Nwankwo (1984)

Pollution of water resources

Water is a unique substance, because it can naturally renew and cleanse itself, by allowing pollutants to settle out (through the process of sedimentation) or break down, or by diluting the pollutants to a point where they are not in harmful concentrations. However, this natural process takes time, and is difficult when excessive quantities of harmful contaminants are added to the water. Water pollution includes all of the waste materials that cannot be naturally broken down by water. Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. It has been suggested that water pollution is the leading worldwide cause of deaths and disease and that it accounts for the deaths of more than 14,000 people daily (Larry, 2006). An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrheal sickness every day. Some 90% of China's cities suffer from some degree of water pollution, and nearly 500 million people lack access to safe drinking water (Larry, 2016). In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well. In the most recent national report on water quality in the United States, 45 percent of assessed stream miles, 47 percent of assessed lake acres, and 32 percent of assessed bay and estuarine square miles were classified as polluted (USEPA, 2007). The above shows that water pollution might be global problem and not peculiarly a Nigeria's Niger Delta problem. However, the work is concerned with the later. Meanwhile water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support human use, such as drinking water, and/or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water.

The problem of water pollution by oil companies and other activities of man have attracted many researchers into analyzing water samples from oil-producing areas. Water quality is paramount in every society because man can leave without a lot of things in a day but not water. Most of the domestic activities of the communities are done with surface water, so polluting it will definitely affect them. Ibisi et al., (2017) analyzed the impact of oil spill on surface water at Obunku in Rivers

State of the Niger Delta Region. From the analyses, four different samples were collected from the pollution source, and other samples from 100m and 200m intervals away from the pollution source, and a control sample was collected from an unpolluted source. The results showed that the values of pH, the total dissolved solids, total petroleum hydrocarbon, total suspended fluid, NO_3^-, and NH_4^+ are indications that the water was polluted. Hence, the oil spillage was the cause of the pollution. Also, the NO_3^-, NH_4^+, Ca^{2+}, K^+, Na^+, and Mg^{2+} contents decrease in distance away from the source. The water quality analysis was conducted on Bayelsa Rivers to evaluate the pollution index using the WHO standard for domestic water supply and permissible levels for the discharge of produced water by the Department of Petroleum Resources. Regression analysis showed a positive correlation of pH, total suspended solids, total dissolved solids, and total petroleum hydrocarbon, respectively, with ions in the water samples. It is also observed that Obunkun River in Oyigbo local government of Rivers State, Nigeria is polluted with regards to pH values, total suspended solids, total dissolved solids, and total petroleum hydrocarbons. Unlike the other three water samples, the control showed no trace of heavy metal and as such the water is not polluted with toxic metals. The pH for the polluted area was within 5.81 to 6.02 while the pH for safe drinking water is 6.5 to 8.5. The UNEP report of 2011 reveal the drinking water in Ogoniland contains carcinogen that is 900 times higher than WHO guideline (UNEP, 2011).

Similarly, an analysis done by Eluchie (2017) on river Brass and river Oloibiri depicted that, the former was highly polluted as compared to the later. The pollution index (PI) in terms of relative damage for Brass and Oloibiri were 2.85 and 2.55 respectively and this difference was attributed to the discharge from oil servicing companies. The safe PI is 1, hence PI above 1 is unacceptable. The chloride contents for the two rivers were higher than the World Health Organization (WHO) standard implying that the water was chemically unsafe for human consumption. The safe chloride concentration is 250mg/L but Brass and Oloibiri rivers recorded concentrations of 9266mg/L and 8485mg/L, respectively. The contamination of surface water was also recorded in the United Nations Environmental Programs report that surface water throughout the creeks in Ogoniland contains hydrocarbons (UNEP, 2011).

Further studies have been conducted on the impact of petroleum production on groundwater since crude oil exploitation is basically a subsurface activity. The results of water samples taken from three active boreholes in Gokana, Ogale and Trans-Amadi communities in Rivers State showed that the water has been polluted by petroleum activities. These activities included artisanal refining, illegal tapping, and other industrial activities. The NH3, pH, acidity, and color among others exceeded the required limit set by the Department of Petroleum Resources (DPR) and Nigerian Standards for Drinking Water Quality (Nwaichi and James, 2012).

Emuedo et al., (2014) also had similar recordings from their research and stated that oil exploration and production have affected the quality of water in the Niger Delta. They then encouraged the companies to organize effective cleanups after spills and also embark on remediation of the water bodies in their sphere of operation. Considering the case of Gokana, Ogale and Trans-Amadi communities in Rivers State the color of the water sample was 5 H.U. which is above the DPR limit of 0.5 H.U. The pH of Gokana and Ogale were between 3.54 and 4.97 which were found below the safe limit of 6.5-9.2 given by DPR. Emuedo et al., (2014) in their studies recorded pH range of 5.03 at Nembe to 5.6 at Okpare. The range of pH values showed that the groundwater is acidic. Another source of water for domestic activities in the region is rainwater. Over a period of time until now, rainwater has not been able to serve the needed purpose because the water the people collect has been acidized (acid rain). Gas flaring alters the ions (nitrate, carbonate, sulphate,) in water usually rainwater and finally leading to acid rain which is quite common in the region (Seiyaboh and Izah, 2017). Acid rain in a community such as Ijaw has affected the quality of their drinking water; their zinc roofing sheets are corroded and increased the contents of heavy metals in their surface water (Raji and Abejide, 2013).

Additionally, the pollution of water bodies has also affected fishing activities. This is because the fishes move to deeper places that are not polluted and also caused some fishermen to resettle or

move farther during fishing. The water bodies are polluted by the dumping of drill mud, drill cuttings and other fluids used to stimulate production. Their chemical component affects aquatic lives negatively which led to reduced catch during fishing and render some drinking water

Environmental ethics and the solution to water pollution in the Niger delta region

Ethics as a moral philosophy aims to discover the highest order and most general moral principles, which serve as general theories of morality (Bassey 2019; Bassey and Pimaro 2019). There are general activities associated with morality in everyday life, passing moral judgments on other people and their behaviour, acting morally or immorally according to one's moral beliefs, offering moral advice and issuing moral commands to others. Though these activities are an important part of everyday morality, however, they do not constitute ethics itself. Unlike everyday morality, ethics is not primarily concerned with giving moral advice or prescribing a set of moral injections like, to be honest, pay your debts, do not lie and so on. Ethics on the other hand is a theoretical discipline, which attempts to find out why any action is right or wrong, that is, what makes an action **-** right or wrong (Eyo 2019; Eyo 2020). Also, a' reason' is addressed to each individual to accept or reject based on its own inherent rational merits. If the reason is a good one and the argument is valid, then being a rational person, you will recognise this and will, therefore, want to accept the conclusion. Each person must see for himself or herself that the reason is a good one and each person must decide for him or herself whether it is good to be a rational person. For this reason, Socrates said, each person must be his own philosopher; 'Man know thy self' (Bassey and Bubu 2019). If you are ill, you must consult a professional doctor and if you are troubled with the law you must hire a professional lawyer. But if you have philosophical problems you must decide this matter yourself. Minimum rationality is the basic requirement to solve philosophical problems. In moral matters, we cannot appeal basically to scientific research, because ethics deals with values, not the empirical facts. Ethics is not the principle of Hedonism, which says anything, that produces pleasure or happiness is good and right.

To be an environmental ethicist, one seems to be an integrated moral practitioner rather than an isolated exploiter of natural resources. The defensive moral judgments easily make circumstances that avoid habitat deterioration, the massive killing of species and the diminishment of biodiversity, population explosion and decline in the quality of life for humans and others. Here, our attitude to people of the future, our attitude to problems such as pollution, resource depletion, population and the extinction of wild species and their habitats, attitude to non-human creatures, etc. will be a responsible guiding force behind lively ecological ethics (Osuala and Nyok 2020). Man's survival on his dear planetary earth home depends on his harmony with nature. Many cultures in the Niger Delta region had an ancient tradition of paying constant attention to the protection of the environment. There are writings and oral galore, to show that in ancient Niger Delta societies every individual had to consciously protect and worship nature. This is because sacred groves were kept unmolested and undisturbed since time immemorial. Some trees were worshiped in the past and rivers were considered goddesses. Cultures warned against deforestation and cutting of trees; they thought that this would result in poor rainfall. Polluting rivers was a taboo in most societies. In fact in the *Annang* culture, one of the cultural groups in the Niger Delta, it was a taboo to use a black pot to get water from the river. The religious leaders also seemed to have a fundamentally positive approach towards the protection of the environment. However, today with the development of science and technology and with ever-increasing world population came tremendous changes in the human and natural environment which has caused major environmental degradation in the Niger Delta region. This often evokes an urgent concern especially in view of the threats to nature posed largely by humans. These environmental threats are both to other humans and to non-humans, placing in jeopardy the communities of life on Earth (Mendie and Eyo 2016; Njar and Enagu 2020). To overcome the threats to our environment we should examine those underlying concepts, attitudes and ideals involved in the relationships between humans and their environment.

Environmental Ethics proper begins from this category that calls for judicious use of the resources with the realization that nature is finite (Eyo 2019; Eyo 2020). Accordingly, it supports environmental ethics that emphasizes careful management or stewardship approach to nature. We all know that human beings have basic needs, such as food, shelter, clothing, health, education, etc. And like Okeke and Akpan (2012) note, human needs or wants are unlimited in a world where

contemporary economic system is rather built according to limited resources especially as offered by nature. This has often presented an ethical dilemma as to who gets what and when to get. The Nigerian government and multi-national oil companies always bank on this ethical dilemma to cheat on the Niger Delta region. Thus it has been argued that a lot of citizens in the country, especially from the region under the discourse, have been deprived of basic amenities and state services, such as provision of clean water, electricity, sanitation; social services like education, health and adequate security to lives and property (Akpan and Etta 2013). Meanwhile it is important to argue that the life support systems have to operate without being over-burdened either by our withdrawal of natural resources or our discharges of waste and pollution. Neither should we forget the cultural and emotional aspects of human life. Sustainability requires that society and nature should be viewed holistically. Some people see sustainable development as a journey or an ongoing process within the limits of ecological frameworks. The long-term aim of this journey is to have as good a life as possible without hurting or harming other fellow humans or living beings. However, damaging environmental impact, the depletion of natural resources and decreased biodiversity are all incompatible with sustainability. These trends have to be reversed to reach the goal of sustainability. Natural values are endangered at every scale **is** not just in the Niger Delta region alone, but also at regional and global levels and this is true in both the developed and the developing nations equally. It is important that as humans are eager to safeguard their rights and needs, so should they give keen attention to conserving the natural value. These last few years, the Niger Delta region has seen an unprecedented growth in the number of automobiles, engineering projects, architectural and oil spillage pollution etc. These have been responsible for the growth of garbage and toxic waste in its waters which continue to pollute and endanger the ecosystem. Every effort must be made to save the region from an irreversible disaster. With the prevalent environmental degradation in the Niger Delta region, we posit that now is the time for the individuals and citizens to demand accountability from the oil companies operating in the area. It is imperative that the Niger Deltans in particular, and indeed, every human being should wake up and think about the Mother Earth because for humans "to be alive is to be a part of our environment and to be separated from it means 'death''. In order to solve the environmental problem in the Niger Delta region, both individuals, cooperate bodies and parastatals must join hands together to achieve this purpose.

Currently, there is no specific environmental legislation to protect fresh water lakes and rivers in Nigeria. In order to prevent environmental degradation around lakes, it may be necessary to limit construction activity, prohibit mining operations and restrict recreation and tourism. Preventive measures to protect lakes and rivers are required to be taken seriously; keeping in view the carrying capacity of the ecosystem operating in the surrounding area. The federal government as well as states government in the Niger Delta regions should enact strict laws to protect her water. A person or body of persons or company should be prohibited from knowingly causing or permitting any poisonous, noxious or polluting matter to be inserted directly or indirectly into a stream, well, sewer or on land. Where an offence is committed by the company or industry, every person who at the time when the offence was committed, or was in charge of the company, and (or) responsible for the conduct of the business of the company, as at that time should be deemed to be guilty of the offence; and is liable to be prosecuted and punished accordingly. In grave cases where there is loss of any life as a result of reckless water pollution as a result of oil exploration, the company's license to operate in the region should be revoked and withdrawn. Where an offence is committed by the company and it is proved that the offence was committed with the consent or connivance of or attributable to any neglect on the part of any director, manager, secretary or other officer of the company, such person should also be deemed guilty of that offence and therefore liable to be prosecuted and punished.

Since the exploitation of groundwater has an impact on a person's fundamental right to life, his or her right to dig or bore oil wells cannot be restricted by an executive order. However, this right may be restricted or regulated by an Act of the legislature. The holder of land has a right to use underground water but he cannot pollute the water and cause damage to neighboring agricultural fields. There should be a national statute regulating groundwater resources. The Niger Delta area should introduce a licensing system to protect ground water resources in the area.

CONCLUSION

The quality of water in an aquatic environment is very important for the survival of its flora and fauna. Water quality also has a role to play in the overall health of an environment. This study is able to show very low pH levels as well as levels of heavy metal much higher than the WHO prescribed limits; indicating the unhealthy state of the Niger Delta environment. The incessant oil spills in the region have led to chronic pollution of the environment with much negative impacts on the mangrove ecosystem. As shown by the study, this has resulted in several environmental degradation. The study has thus shown that oil activities have adversely affected water quality in the mangrove ecosystem with overall negative effects on the sustainability in the Niger Delta environment.

We have argued that the individuals, government and the multinational oil corporations should be morally concerned about our environment. To heal the environment and the people suffering from the devastating effects of oil pollution on the waters, we have argued that there is the urgent need to carry out proper and conscious cleanup of all subsequent oil spills and embark on a remediation of the water bodies in the region. We have also argued that there is need for adequate environmental legislation with regard to oil exploration; hoping that this will regulate the professional attitude of the oil workers as well as the lives of the indigent citizens.

REFERENCES

1. Adetunji, O. V., Odetokun, A. I. (2011). Groundwater Contamination in Agbowo Community, Ibadan Nigeria: Impact of Septic Tanks Distance to Wells. Malaysian Journal of Malaysian Journal of Microbiology, 7(3): 159-166
2. Akpan, C. O. and Etta, P. T (2013) Asouzus Complentary Ontology as a Panacea to the Problem of Ethnic Idolization in Nigeria. *British Journal of Arts and Social Siences,* 15(2), 122 - 132
3. Akpan, W. (2006). Between responsibility and rhetoric: some consequences of CSR practice in Nigeria's oil province. Development Southern Africa, 23, 223-240.
4. Alagoa, E. (2005). A History of the Niger Delta, an Historical Interpretation of Ijo Oral Tradition Port Harcourt, Onyoma Research Publications.
5. Asamoah-Boateng, E. K. (2009). Physico-chemical and Microbiological Quality of Surface Waters within the Newmont Ghana Gold Mining Concession Areas. MSc. Thesis Submitted to the Department of Theoretical and Applied Biology, Kwame Nkrumah University of Science and Technology, Kumasi. p16.
6. Bassey, S. A. (2019). 'Anthropoholism'As an Authentic Tool for Environmental Management. *International Journal of Environmental Pollution and Environmental Modelling*, 160-168.
7. Bassey, S. A., and Bubu, N. G. (2019). Gender inequality in Africa: a re-examination of cultural values. *Cogito: Multidisciplinary Res. J.*, *11*, 21.
8. Bassey, S. A., and Pimaro Jr, T. M. (2019). Enyimba's Notion of Madukaku and the Question of Anthropocentricism in African Environmental Ethics. *International Journal of Environmental Pollution and Environmental Modelling*, 129-136.
9. Bowen, H. J. M. (1975). Water pollution. *EDUC. CHEM.*, *12*(1), 16–18. https: / / doi.org / 10.4324 / 9781315208343-18
10. Community Water and Sanitation Division (CWSD), (1999). 'Completion Report on Borehole Construction in Six Districts of Ashanti Region, Kumasi. (Unpublished)
11. Delt, W. and Igben, J. L. (2012). Environmental Degradation. Sacha Journal of Environmental Studies, 2, 70-80.
12. Duke, E. O. (2020). From Christian spirituality to eco-friendliness. *International Journal of Humanities and Innovation (IJHI)*, *3*(1), 34-38.
13. Eluchie, P. N. (2017). Assessment of Water Quality of Bayelsa Rivers Using Pollution Index. International Journal of Bioorganic Chemistry, 2(1), 16–21

14. Emuedo, O. A., Anoliefo, G. O. and Emuedo, C. O. (2014). Oil Pollution and Water Quality in the Niger Delta: Implications for the Sustainability of the Mangrove Ecosystem. Global Journal of Human-Social Science, Geo-Sciences, Environmental Disaster Management, 14(6), 1–9.
15. Eyo, U. E. (2019). Between Religion and Agriculture: A Roadmap to Revamping Nigeria's Economy. *GNOSI: An Interdisciplinary Journal of Human Theory and Praxis*, *2*(1), 62-70.
16. Eyo, U. E. (2020). Creation accounts in Gen. 1 and 2: A Feminist Interpretation. *International Journal of Humanities and Innovation (IJHI)*, *3*(1), 29-33.
17. Howarth, W. (2018). Water pollution and water quality. In *Routledge Handbook of Water Law and Policy* (pp. 78–94). https: / / doi.org / 10.4324 / 9781315651132-7
18. Ibisi, N. E., Ojo, M. O., and Ano, A. O. (2017). Effects of Crude oil spills on Surface water in Niger-Delta Region of Nigeria. American Journal of Engineering Research, 5(5), 210–216.
19. Ishaku, H. T., Majid, M. R., Ajayi, A. A., and Haruna, A. (2011). Water Supply Dilemma in Nigerian Rural Communities: Looking Towards the Sky for an Answer. Journal of Water Resource and Protection, 03(08), 598–606.
20. Israel Water Authority. (2015). *Monitoring and prevention of water pollution*. Israel Water Authority Publication. https: / / doi.org / 10.1186 / 1471-2105-15-139
21. Jain, C. K., Bhatia, K. K. S., Vijay, T. (1995). Ground Water Quality Monitoring and Evaluation in and Around Kakinada, Andra Pradesh, Technical Report, CS (AR) 172, National Institute of Hydrogeology, Roorkee, 1994-1995.
22. Larry, W. (2006). World Water Day: A Billion People Worldwide Lack Safe Drinking Water.
23. Mallard, G. E. (1982). Microorganisms in Water: In USGS circular 848. Microbiology of the Aquatic Environment, 25-33
24. McMurray, J., Fay, R. C. (2004). Hydrogen, Oxygen and Water. In: McMurray Fay Chemistry. Kp. Hamann, 4th Edn. New Jersey: Pearson Education, 575-599
25. Mendie, P. J., and Eyo, E. (2016). Environmental Challenges and Axiology: Towards A Complementary Study in Eco-Philosophy. *Journal of Integrative Humanism*, *7*(1), 144-150.
26. Mendie, U. (2005). The Nature of Water. In: The Theory and Practice of Clean Water Production for Domestic and Industrial Use. Lagos: Lacto-Medals Publishers, 1-21
27. NDDC 2006. Niger Delta Regional Development Master Plan. In: GOVERNMENT, O. O. T. S. T. T. F. (ed.). Abuja: South-Sea Datcomm Limited.
28. Njar, B. I., and Enagu, D. A. (2020). Development and Environmental Sustainability in Nigeria: An African Perspective. *GNOSI: An Interdisciplinary Journal of Human Theory and Praxis*, *2*(1), 37-47.
29. Nouri, J., Mahvi, A. H., Babei, A. A., Jahed G. R., Ahmedpour, E. (2006). Investigation of Heavy Metals in Groundwater. Pak. J. Biol. Sci, 9(3):377-384
30. Nwaichi E.O. and James I.O. (2012). Groundwater Quality Assessment in Selected Niger Delta Communities in Nigeria. Journal of Environmental and Analytical Toxicology, 02(03), 3–7.
31. Nwankwo, N. and Ifeadi, C. (1988). Case studies on the environmental impact of oil production and marketing in Nigeria. University of Lagos, Nigeria
32. Nwankwo, N. Oil and Environment Pollution. In: NISER, ed. Strategies for the Fifth National Development Plan 1986-1990, November 1984 Ibadan. Nigerian Institute of Social and Economic Research
33. Nwilo, P. and Badejo, O. (2005). Oil spill problems and management in the Niger Delta. International Oil Spill Conference, 2005. American Petroleum Institute, 567-570.
34. Nwilo, P. and Badejo, O. Oil spill problems and management in the Niger Delta. International Oil Spill Conference, 2005. American Petroleum Institute, 567-570.
35. Nwilo, P., C. and Badejo, O., T. (2007). Impacts of Oil Spill Pollution along the Nigerian Coastal Areas. International Federation of Surveyors.
36. Obiri-Danso, K., Adjei, B., Stanly, K. N., Jones, K. (2009). Microbiological Quality and Metal Levels in Wells and Boreholes Water in Some Peri- Urban Communities in Kumasi Ghana. African Journal of Environmental Science and Technology 3(1): 059-066
37. OECD Studies on Water. (2017). Diffuse Pollution, Degraded Waters. In *Oecd*. https: / / doi.org / 10.1787 / 9789264269064-en

38. Okeke, J and Akpan, C. (2012). An Inquiry into the Moral Question of Xeno-transplantation. In *online Journal of Health Ethics*. 8 (1), 1-13
39. Osuala, A. N. ., and Nyok, E.-I. E. (2020). New Twist to Political Corruption in 4th Republic Nigeria given Non- Human Animals stealing millions: A Case for the Defense of Animal Rights. *GNOSI: An Interdisciplinary Journal of Human Theory and Praxis*, *1*(2), 15-37.
40. Raji, A. O. Y., and Abejide, T. S. (2013). An Assessment Of Environmental Problems Associated With Oil Pollution And Gas Flaring In The Niger Delta Region Nigeria, C. 1960s-2000. Arabian Journal of Business and Management Review, 3(3), 48–62
41. Sabhapandit, P., Saika, P., Mishra, A. Kr. (2010). Statistical Analysis of Heavy Metals from Water Samples of Tezpur Sub-division in Sonitpur District, Assam, India. Int. Journ. of Applied Biol. and Pharm. Technol. 1(3): 946.
42. Seiyaboh, E. I., and Izah, S. C. (2017). A Review of Impacts of Gas Flaring on Vegetation and Water Resources in the Niger Delta Region of Nigeria. International Journal of Economy, Energy and Environment, 2(4), 48–55.
43. Sullivan, C.A., Cohen, A., Faures, J.M. and Santini, G. (2008). The Rural Water Livelihoods Index: Working Paper. Food and Agriculture Organization. http://www.fao.org/nr/water/docs/FAOW_RWLI_paper.pdf.
44. Udoh, I. A., Stammen, R. M. and Mantell, J. E. 2008. Corruption and oil exploration: expert agreement about the prevention of HIV/AIDS in the Niger Delta of Nigeria. Health education research, 23, 670-681.
45. UN water. (2010). Clean water for a healthy world. *Development*, 1–16. http://www.unwater.org/wwd10/downloads/WWD2010_LOWRES_BROCHURE_EN.pdf
46. UNDP 2006. Niger Delta Human Development Report. Abuja, Nigeria: United Nations Development Programme.
47. UNEP 2011. Environmental Assessment of Ogoniland. Nairobi, Kenya: Uniten Nations Environment Programme.
48. United States Environmental Protection Agency (USEPA) (2002). Drinking Water from Household Wells. http//www.epa.gov/safewater/drinklink.html.
49. USGS (2009). What is Groundwater? U .S Geological Survey Open File Report 93-643 http://pubs.water.usgs.gov/ofr93643
50. Vanloon, G. W., Duffy, S. J. (2005). The Hydrosphere: In Environmental Chemistry: A Global Perspective. 2nd Edition. New York: Oxford University Press, 197-211
51. WHO (2000). The World Health Report: Making a Difference. World Health Organization, Geneva
52. WHO (2007).Water for Pharmaceuticals Use, In: Quality Assurance of Pharmaceutical: A Compendium of Guidelines and Related Materials. 2nd updated Edn. World Health Organization, Geneva, 2: 170-187
53. WHO/UNICEF (2010). Report of the WHO/UNICEF Joint Monitoring Programme on Water Supply and Sanitation. New York and Geneva, United Nations Children's Fund and the World Health Organization
54. World Water Day (2010). Clean water for a healthy world. World Water Quality Facts and Statistics. 510-251-1600X106