

IMPACT OF OIL POLLUTION ON NIGER-DELTA COMMUNITIES IN NIGERIA: A REVIEW

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Abstract

The oil industry in Nigeria has contributed immensely to the economic and infrastructural growth of the country. Oil producing communities in the Niger-Delta have however complained that they have not been part of this development rather their land and rivers are being polluted. This paper examined the impact of oil pollution on Niger-Delta communities. The major causes of oil spillage in the region include equipment failure and pipeline vandalization. Oil spills affect the physical and chemical properties of land and water which reduces farming and fishing activities. This results in low food production, food shortage, loss of income, poverty and hunger. There is contamination of drinking water and water for other domestic uses. Other effects of oil pollution include loss of biodiversity and ill health caused by ingestion and inhalation of hydrocarbons. The issues of control of oil pollution should be taken more seriously by the government and oil companies. The various government agencies established to provide social, educational and health infrastructure for oil communities must fulfill their mandate.

Keywords: Oil pollution, vandalization, poverty, ill-health, water, soil.

The Niger Delta region is located along the Atlantic coast of southern Nigeria and is the world's second largest delta with a coastline of approximately 450km (Okonkwo, Taylor and Kamar, 2015). With a size of about 20,000km², the region is considered the largest wetland in Africa. The delta mangrove swamp which covers about 1900km² is the largest mangrove swamp in Africa (Okonkwo, *et al.*, 2015). Niger delta is a typical rainforest zone that can be classified into four ecological zones, coastal inland zone, freshwater zone, lowland rainforest zone and mangrove swamp (Ogbe 2015; Omofonwan and Odia 2009). With a population of about 30 million people in 2005, the Niger Delta account for more than 23% of Nigeria population. It is made of nine states, Abia, Akwa Ibom, Cross-River, Delta, Edo, Ondo, Imo and Rivers (Ohwofasa, Anuta and Aiyedogbon, 2012). The Niger delta is located at the apex of the Gulf of Guinea on the west coast of Africa and is roughly synonymous with south-south geographical zones. It makes up 7.5 % of Nigeria's land mass (Ite, Ibok, Ite and Peters, 2013). The Niger Delta mangrove swamp is the third largest in the world. It is also the richest part of Nigeria in terms of petroleum resources and natural ecosystem which support numerous species of terrestrial and aquatic fauna and flora (Ite *et al.*, 2013). This study examined the effects of oil pollution on the environment and livelihood of people of the Niger-Delta region.

Causes of Oil Pollution

Egbe and Thompson (2010) distinguished between natural and man-made causes of oil pollution. Natural causes include movement of tectonic plates that can rupture pipelines and oil seepage from the ground especially in the oceans. Man-made causes are oil bunkering, sabotage, accidents, and poor handling of equipment and facilities. Oil spills also result from pipelines and storage facilities failure, material defect and pipeline corrosion (Kadafa, 2012). The main causes of oil spills in the Niger-Delta are vandalism, oil blowouts from flow stations, accidents and deliberate release of oil by tankers. Oils in urban runoff and industrial effluents discharges also contribute to pollution (Zabbey, 2009). Pollution arising from fuel and oil mixtures released by outboard engines is

a potential threat to the environment, 10 – 20% of the fuel used in two-stroke outboard engines are discharged into water. There is no consensus on whether sabotage and vandalization or technical failure constitutes the major cause of oil spillage in Nigeria. Gasoline is commonly used as fuel in most outboat engines in the Niger delta. Since these engines are inefficient compared to other internal combustion engines, significant amount of fuel is released into the aquatic ecosystem. While Raji and Abejide (2013) estimated that 21% oil spills were caused by equipment failure, 60% due to sabotage and 19% due to human error. Egbe and Thompson (2010) noted that 28% of oil spills were caused by sabotage, 50 % by corrosion of pipelines and accidents, 21% by production operations and 1% due to error or poor handling.

Oil bearing communities have always argued that all oil spillages were caused by old and corroded pipelines that were due for replacement and various forms of equipment failure, thereby putting the blame on the oil companies. They are very quick to ask for compensation for the damages resulting from the spills. The oil companies on the other hand reject most calls for compensation claiming that most oil spills were caused deliberately by the communities in order to demand for compensation.

Effects of Oil Pollution

The effects of oil pollution are being examined with respect to soil, crop yield, fishing, biodiversity, water quality, health and the economic life of the host communities.

Effects on Soil

Oil spillage is a major contaminant of agricultural soils in the Niger Delta and thus affects soil fertility, soil pH, moisture content, salinity, electrical conductivity (EC), soil texture and structure, heavy metal and total hydrocarbon content of agricultural soils (Egbe and Thompson, 2010; Oyem and Oyem, 2013 and Ugboma, 2014).

Okoro, Oviasogie and Oviasogie (2011) assessed the soil quality of Orere-Oluba community in the Niger Delta and observed a decrease in pH, electrical conductivity, nitrates and phosphate in the oil polluted soils compared to non-polluted soils. There was significant increase in total organic carbon and total petroleum hydrocarbons (TPH) with a slight increase in clay content and heavy metal in the polluted soil compared to the control.

Oil polluted soils in Udu Community showed a significant loss of soil fertility with reduction in soil porosity and permeability (Ugboma, 2014). In Ugborodo Community, there was significant increase in TPH, electrical conductivity and salinity in oil polluted soils compared to non-oil polluted soil. The oil impacted soil had high moisture content with poor aeration, was more acidic and with higher bulk density (Oyem and Oyem, 2013). In Owaza Community, the concentrations of macronutrients N, P and K were significantly lower in oil impacted soils than in unimpacted soils. This decrease in macronutrients may be due to increased microbial degradation of hydrocarbons. The contaminated soil also developed severe and persisted water repellency. Other studies in the Niger Delta showed that oil in soil reduces essential nutrient available for plants and alters the physical and chemical properties of the soil (Abii and Nwosu, 2009).

Effects on Food Production

Food production in the Niger Delta has been affected by oil spillage. A study of 262 crop farmers drawn from 10 communities and 5 local government areas of Delta State in the oil producing agro-ecological zone showed that oil spill reduced crop yield, land productivity and also depressed farm income. A 10 percent increase in spilled oil lead to 13percent reduction in crop yield and 5 percent decrease in farm income. According to Egbe and Thompson (2010) oil pollution causes wilting and death of crops like pepper and tomatoes due to blockage of stomata openings which inhibit photosynthesis, transpiration and respiration. When oil spills occur in a farm most crops in the farm are usually destroyed. Nkwocha and Duru (2010) studied the effect of oil pollution on local plant species and cultivated food crops over a period of fifteen months. It was observed that young plants were more venerable to oil pollution than old plants, and they showed partial defoliation, leaf

loss and high level of heavy metals. A total of 43 species of plant from 20 families were recorded in unpolluted site while only 25 plant species from 10 families were enumerated in oil polluted site. The level of heavy metals were relatively higher in leaves of local crops such as cassava and pumpkin in polluted site than in control sites. In addition to contamination of crops, animals such as snakes, lizards and alligators migrated from polluted sites in search of prey.

Several studies have shown that seed germination and plant growth is affected by oil pollution. Oyedeji, Adebisi, Omotoyinbo and Ogunkunle (2012) observed that crude oil pollution hindered germination as well as plant heights and girth of *Abelmoschus esculentus*, a widely cultivated crop in Nigeria. Two crude oil types in Nigeria, Forcados light and Escravos light also inhibited germination and seedling growth of *Zea mays*. Firiappah, Okujagu and Bassey (2014), also confirmed that high levels of crude oil applied to soil before planting prevented the germination of *Hibiscus esculentus* (okra) while application after germination resulted in stunted growth. Ogbo (2009) studied the effects of diesel on four crop plants, *Arachis hypogaea*, *Vigna unguiculata*, *Sorghum bicolor* and *Zea mays*. The study showed that the phytotoxicity of different levels of diesel contamination on seed germination varied with the type of seed and level of contamination. Germination was reduced in all four crops with increase in concentration but *Z. mays* and *A. hypogaea* showed more resistance to pollution. Seed emergence and growth of cowpea in crude oil polluted soil were inhibited, while there was decrease in stem height, leaf number and protein content with increasing crude oil contamination (Gbadebo and Adenuga, 2012). After an oil spill, crops recover differently, tuberous crops like yam and cassava were most adversely affected even in lightly contaminated soils and only minimal regrowth occurred after six months. Mango trees and *rhizomatous* plantain and banana trees, appeared to be most adaptable and after an initial defoliation recovered quickly in moderately contaminated areas, whereas palm trees did not become re-established for quite some time (Ojimba and Iyagba, 2012).

Fishing is a major economic activity in the Niger Delta. Fish is the main source of protein for the people. Oil pollution of traditional fishing grounds have led to hunger and poverty in fishing communities. Fishermen have abandoned their nets in search of non-existing paid employment (Egbe and Thompson, 2010). The death of fishes in polluted waters results from fishes ingesting the spilled oil or other food materials impregnated with oil and dying. Fishes escaping pollution migrate out of the fishing zone to the deep sea where local fishermen cannot reach. In some cases when the fishes are not killed, they become inedible and unpalatable when eaten (Ohwofasa *et al.*, 2012). Seiyaboh, Ogamba, Utibe and Dike (2013) reported that Bonny light crude oil was toxic to Tilapia. Mortality rate of the fish was concentration dependent. At 0.02% oil pollution all the exposed fishes died, while at 0.01% concentration 50 % of the fishes were killed. This is in agreement with the findings of Kakkar, Saxena and Pandey (2011) who observed that fish exposed to petroleum hydrocarbons showed restlessness, jumped erratically, surfaced frequently and had increased opercular movement. In addition, the fish skin was damaged and there was increased mucous secretion. Apart from fish, other aquatic animals such as crustaceans like shrimps, crabs and crayfishes which are important source of food and income in the Niger Delta are also negatively affected by oil pollution (Ohwofasa *et al.*, 2012).

Effects on Water Quality

Studies have shown that most freshwater sources in the Niger Delta are contaminated by petroleum hydrocarbons. Raji and Abejide (2013) reported that drinking water from a freshwater swamp in Ogoni Community in the Niger Delta was analyzed for petroleum hydrocarbons. The result showed that the water contained 18ppm of hydrocarbon which was about 360 times more than the level permitted in drinking water by the European Union. The study also reported that between 76 – 80 % of people in the rural areas and 50 – 56 % in the urban areas of the Niger Delta lack access to drinking water due to oil pollution.

Uzoekwe and Oghosanine (2011) investigated the effect of treated effluent discharge from the Warri Refinery and Petrochemical Company on Ubeji River which is a major source of water for the Ubeji Community. The study revealed that because the effluent were treated some of the physico-

chemical parameters measured were within the limit set by Federal Ministry of Environment, Nigeria for aquatic life but not for domestic use by the community. Earlier studies by Achudume (2009) and Nduka and Orisakwe (2009) showed that the water from Ubeji River was unfit for domestic use and unsafe for aquatic life. Olukunle (2013) examined the physico-chemical properties of oil polluted water collected from six communities in Ondo and River States of Nigeria and observed that the water were not safe for domestic use.

In Ilaje Community of Ondo State, oil exploration activities have resulted in the introduction of petroleum hydrocarbons into the rivers and streams. An estimated volume of 68.4% of both surface and underground water has been contaminated making accessibility to drinking water extremely difficult (Balogun and Kareem, 2013). Similar study by Uzoekwe and Achudume (2011) observed the Ughoton stream in Ughoton Community in the Niger Delta was covered by oil films making the water unfit for use by the community. Three of Nigeria's four refineries are located in the Niger Delta. These refineries generate large quantities of effluents daily which are discharged into natural water bodies untreated or after treatment. The discharge of effluents from the two Port Harcourt refineries into the Okrika arm of the Bonny River estuary resulted in the presence of high concentrations of pollutant in the water which may be toxic to different aquatic organisms. Generally, higher concentrations of pollutants were observed in the dry season than in the rainy season. Akporido and Onianwa, (2015) investigated the heavy metal and total petroleum hydrocarbon concentrations in surface water of Esi River in the Western Niger Delta. The study showed high level of petroleum hydrocarbons in the river from crude oil related activities in the area. When compared with established standards for drinking water the Esi River was considered not fit for drinking and other domestic use. UNEP (2011) investigated oil pollution in Ogoni Community and observed that the surface water throughout the creeks contained hydrocarbons with floating layers of oil which vary from thick black oil to thin sheens visible in most of the creeks. The highest level of dissolved hydrocarbon in the water column was $7,420\text{mgL}^{-1}$ detected at Ataba-Otokroma.

In addition to surface water, groundwater is also a major source of water for domestic use in many communities in the Niger Delta. Groundwater is rainwater or water from surface water bodies, like rivers, lakes or streams that permeate into the soil and bedrock and is stored underground in the pores spaces between soil particles (Adekunle, Badejo and Oyerinde, 2013). Water from boreholes from Egbema community was analysed and the results showed that boreholes in oil polluted sites had higher total hydrocarbon content than boreholes from unpolluted sites, suggesting that the water from the polluted boreholes were unfit for drinking (Nwachukwu and Osuagwu, 2014). UNEP (2011) reported that water taken from 28 wells in 10 communities near oil spill sites in Ogoniland was contaminated with petroleum hydrocarbons. The value of hydrocarbons in the water samples from seven wells were 1,000 times higher than the Nigerian drinking water standard of $3\mu\text{gL}^{-1}$. Even though local communities were aware of the pollution and associated risk, they continued to use the well water for drinking, bathing, washing and cooking because there was no alternative.

Effects on Biodiversity

Biodiversity is the variation in the number of organisms occurring in an ecosystem. This includes the number of different species, the genetic variation within species and the variety of interactions among species in a community also know as ecosystem diversity. The higher the number of species, the greater and richer the biodiversity. The Niger-Delta is classified into four ecological zones namely coastal inland zone, freshwater zone, lowland rainforest zone and mangrove swamp zone. It is one of the most important wetland in the world (Kafada, 2012). The Niger Delta region harbor a rich diversity of wildlife which include mammals, reptiles, birds, insects and other invertebrates, and several plant species which are native to the region. About 60-80% of all Nigerian plant and animal species are found in the Niger Delta region. Among the animals present in the Niger Delta include the mona monkey, speckle-throated otter, genets, black squirrel, apes and chimpanzee. Over 330 different bird species have been identified and the Niger Delta is an important habitat in the trans-hemisphere migrating route of bird species. The plant species abundant in the Niger Delta include the rich mangrove forest made up of the red mangrove (*Rhizophora recemosa*), black

mangrove (*Laguncularia racemosa* and the white mangrove (*Avicennia africana*). Among the common trees include *Lophira alata*, *Pycnanthus angolensis*, *Uapaca sp.*, *Hallea ledermannii*, *Sacoglottis gabonensis* and the oil palm (*Elaeis guineensis*) (Zabbey, 2009; Ugochukwu and Ertel, 2008; Kadafa, 2012).

Nigeria has the third largest mangrove forest in the world and the largest in Africa which is about 9,730km² in size (Chindah, Braide, Amakiri and Onokurhefe, 2011). The mangrove swamp in the Niger Delta covers between 5400km² and 6000km². There are three main mangrove families; Rhizopharaceae, Avicenniaceae and Combrataceae with the red mangrove constituting about 60% of the mangrove forest in the Niger Delta. The mangrove swamp provides breeding ground for many aquatic fauna and its loss will reduce biodiversity in the region (Zabbey, 2009). According to the UNEP (2011) report, oil pollution has destroyed the mangrove forest turning it into bare ground with few scattered root covered will oil without leaves and stems. Chindah *et al.*, (2011) investigated the effect of Bonny light crude oil on mangrove and reported that the oil reduced stem height and diameter, leaf length, width and number of leaves, senescence and seedlings survival. Their complex breathing and stilt roots system make the mangrove trees vulnerable to crude oil coating. Biodiversity is beneficial for air and water purification, conservation and the reduction of environmental degradation (Raji and Abejide, 2013).

Oil exploration and exploration activities such as use of dynamites, laying of pipelines, drilling and transportation of oil lead to the distortion in the habitat which have deleterious effects on the local ecosystem and biodiversity. Breeding grounds are destroyed both in terrestrial and aquatic ecosystems, leading to migration while non-motile species are killed and reproductive cycles are disrupted. Ohwofasa, Anuta and Aiyedogbon (2012) noted that in a community in the Niger Delta, the mangrove trees started dying within six months of crude oil pollution, crabs, molluscs and periwinkles were killed while the accompanying fire consumed 25 hectares of forest rich in diverse species. In Udu-Ughievwen community in the Niger Delta region several medicinal plant species were destroyed by oil spill (Mogborukor, 2014). Zabbey (2009) identified the importance of biodiversity to include provision of food, employment, aesthetic, energy (firewood), tourism, spiritual or sacred functions, medicine, shelter and conservation of natural resources. Thus the loss of biodiversity is a major resource loss in the Niger Delta and all aspect of oil exploration and exploitation have effects on local biodiversity.

Effects on Public Health

Oil spills contain heavy metals, aromatic hydrocarbons and other toxic contaminants that affect the health of the people living in oil producing communities in the Niger Delta (Egbe and Thompson, 2010; Aguilera *et al.*, 2010; UNEP, 2011; Balogun and Kareem, 2013; Oyebamiji and Mba, 2014).

Heavy metals and trace elements like chromium and barium found in oil spills have been linked to diseases like stomach upset and ulcers, kidney and liver damage, high blood pressure and tumors (Egbe and Thompson, 2010). Burning of spilled oil and gas flaring produce sulphur dioxide and nitrogen dioxide which combine with water in the air to cause acid rain (Tawari and Abowei, 2012). Since some communities depend on rain water for domestic use, they may suffer from intestinal disorder, skin rashes and respiratory problems (Omofonwan and Odia, 2009). Studies have shown that Bonny light crude oil have testicular toxicity and nephrotoxicity effect on albino rats. Crude oil pollution maybe implicated in infertility and the inhalation of gaseous pollutants from petroleum hydrocarbon combustion may lead to respiratory and lung disorders such as asthma and bronchitis (Tawari and Abowei, 2012).

UNEP (2011) reported that air samples from Ogoni community in the Niger Delta contained benzene, a carcinogenic compound in concentrations ranging from 0.155 to 48.2 µgm⁻³. About 10 percent of samples of detected benzene concentrations were higher than the limit set by World Health Organization (WHO) and United States Environment Protection Agency (USEPA).

Ordinioha and Brisibe (2013) reported that carcinogens like benzene and polycyclic aromatic hydrocarbon (PAH) were present in surface water and soil of oil impacted communities. Ana, Sridhar

and Azuzu (2010) observed that the presence of these carcinogens maybe responsible for the high prevalence of certain types of cancers in Port Harcourt, a city in the Niger Delta compared to Ibadan outside the Niger Delta. Crude oil spill could cause a 45% increase in radiation level which is carcinogenic. The radiation contamination caused by crude oil spill in the Niger Delta impact surface water and crops grown in the crude oil contaminated soil beyond the maximum permissible limit (Meindinyo and Agbalagba, 2012). The ingestion, dermal contact and inhalation of the other constituents of spilled crude oil have acute and long-term health implications (Ordinioha and Brisibe 2013). The level of exposure of inhabitants of impacted communities to spilled oil is high because they continue to fish, farm and use the polluted water for domestic purposes in the absence of alternatives (UNEP, 2011). Vapours or smoke from burning oil contain volatile organic compounds which when inhaled cause headaches, dizziness, nausea, vomiting, eye and throat irritations and breathing difficulties including hydrocarbon pneumonia (Best and Seiyefa, 2013).

Effects on Income and Economy

Oil revenue accounted for 88% of the Federal Government's foreign exchange earnings in 1997 and 83.5% of the total gross revenue in 2000 (Kadafa, 2012). The revenue from oil led to massive infrastructural development in many Nigeria capital cities including Lagos and Abuja with flyovers, dual carriage ways and skyscrapers visible everywhere. Meanwhile the communities that produce this revenue are characterized by poverty and hunger, with no access to electricity, good roads, portable water, health care and quality education (UNEP, 2011; Oteh and Eze, 2012 and Ordinioha and Brisibe, 2013).

The people of the Niger Delta are traditionally farmers, hunters and fishermen. Oil pollution has led to the destruction of forest, loss of fertile land and reduction in fish population (Kadafa, 2012). This has resulted in loss of income to hunters, farmers and fishermen (Ite, Ibok, Ite and Peters 2013). Oyebamiji and Mba (2013) assessed the effects of oil spillage on poverty and hunger in the Niger Delta and observed that there was high level of youth unemployment, increase in poverty rate and hunger. According to Ugwuanyi, Garba and Makarua (2012) more than 60% of the people in the Niger Delta depend on the natural environment for their livelihood, therefore environmental quality and sustainability are fundamental to their overall wellbeing and development. Most of the people affected by oil spills are the poorest and those who rely on traditional livelihoods such as fishing and agriculture. Ojimba and Iyagba (2012) examined the effects of crude oil pollution on horticultural crops in Rivers State, Nigeria. The result showed that the yield of crops in crude oil polluted farms (15.98tons) were lower than in non-polluted farms (18.75tons) while the farm income realized per farm was also lower in crude oil polluted farms (\$324.20) compared to unpolluted farms (\$365.84).

Tourism and recreational activities in the Niger Delta are affected by oil spillage. When beaches and other water fronts are polluted recreational activities such as swimming, boating and diving cannot take place. Owners of hotels and restaurant, photographers and other service providers lose income (Egbe and Thompson, 2010). With no land to farm and waters to fish, the people are forced to look for non-existing jobs. Since they do not have the requisite skills and training for the technical jobs available they settle for temporary construction jobs such that they work for a few mouths and are out of work for a longer period. Thereby keeping them in a perpetual state of poverty.

Apart from destruction of natural fishing grounds, oil spills have also affected entrepreneurs who established fish farm close to the creeks and streams. Their investment have been lost and those who took loans from banks and other finance institutions have become bankrupt (UNEP, 2011). The high level of unemployment and poverty is responsible for the youth restiveness and militancy seen the Niger Delta. Out of frustration the youths engage in vandalization of pipelines, oil theft, illegal refining of crude, kidnapping of oil workers and sabotage of oil installations. In response to agitations by communities and political leaders from the Niger Delta, the Federal government established the Oil Mineral Producing Areas Development Commission (OMPADEC) in 1992 but it was replaced by the Niger Delta Development Commission (NDDC) in 1999. This intervention agency together with the Ministry of Niger Delta established in 2008 were to focus on the infrastructural and human resource development in the Niger Delta. In addition, 13 % of the oil revenue was also to be given to the oil

producing states as derivation fund. The impact of this policies on the economic and infrastructural development of the Niger Delta Communities have been minimal because of the high level of corruption by those in charge of these agencies and funds (UNEP, 2011; Ohwofasa *et al.*, 2012; Oteh and Eze, 2012 and Ugwuanyi *et al.*, 2012).

Conclusion

Oil producing communities in the Niger-Delta suffer ecological and economic damages resulting from the exploration and exploitation of crude oil and yet enjoy little of the oil revenue Nigeria earns. The level of poverty of the people coupled with lack of good roads, electricity, educational institutions and health facilities have led to anger and frustration. This has resulted in self help seen in vandalization of pipelines and the setting up of illegal oil refineries which produce more pollution.

Recommendations

The following are therefore recommended.

- i. Oil companies must be made to maintain the same safety standards; they keep in countries such as United States of America, Britain, France and Italy where the parent companies are located.
- ii. Adequate compensation should be paid to victims of oil spillages both at the individual level and the community level.
- iii. Oil companies should be made to respond early to oil spills to mitigate their effects on the environment. Penalty should be introduced for delay or failure to respond to spills.
- iv. Oil producing communities should be provided facilities for their education, health, economic and social needs.
- v. Employment opportunities should be provided for the large number of unemployed youths in the Niger-Delta to reduce the incidents of pipeline vandalization.

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