



International Journal of
Agricultural Sciences
and Natural Resources

Keywords

Ecological Effects,
Oil exploration,
Niger-Delta,
Sustainable Development,
Nigeria

Received: September 17, 2014

Revised: September 25, 2014

Accepted: September 26, 2014

Review of ecological effects of oil exploration in the Niger-Delta, Nigeria

Emmanuel Teryila Tyokumbur

Ecology and Environmental Biology Unit, Department of Zoology, University of Ibadan, Ibadan, Nigeria

Email address

e.tyokumbur@mail.ui.edu.ng

Citation

Emmanuel Teryila Tyokumbur. Review of Ecological Effects of Oil Exploration in the Niger-Delta, Nigeria. *International Journal of Agricultural Sciences and Natural Resources*. Vol. 1, No. 4, 2014, pp. 76-80.

Abstract

A review was carried out on the ecological effects of oil exploration in the Niger-Delta region of Nigeria. The Niger-Delta is a vast bird foot-shaped floodplain and the World's third largest delta. It is a geographical entity situated in the central part of Southern-Nigeria that is home to the oil-producing states of Nigeria. Oil activities and its ecological effects are discussed with remediation of affected sites. Sustainable development is recommended in the sector to boost the economy and meet the environmental quality aspirations of host communities.

1. Introduction

The Niger Delta Area is located in the South-South region of Nigeria, with a total area of 7,722.04 square miles, and located between $4^{\circ}15'N$ and $4^{\circ}50'N$ and $5^{\circ}25'E$ and $7^{\circ}37'E$ (Powell *et al.*, 1985). The population of the area is about 31 million (CRS, 2008), (Akintola, 1982). The accumulation of marine sediment buildup and fluvial activities during the upper Cretaceous, led to the formation of the Niger Delta, which is typified by widespread interconnectivity of deltaic tributaries, mangrove swamps, flood plains, creeks, and coastal barrier islands. The soils is of fluvial origin, characteristic of the back-swamps soils include peat covered water-logged weighty clay whereas clay and silty loamy soils found in elevated areas (Rahaman, 1976). The region is home to the oil-producing states of Nigeria namely Abia, Akwa Ibom, Bayelsa, Cross-River, Delta, Edo, Imo, Ondo and Rivers (Nwokolo, 2001). The oil-rich area is home to Nigeria's vast crude oil reserves, which stands at nearly 40 billion barrels excluding its enormous natural gas reserves, which is estimated at approximately 100 trillion cubic feet (Abulu, 2001). The Niger Delta is the world's largest mangrove forest, West Africa's most extensive freshwater swamp forest, Nigeria's last remaining rainforests and one of the continent's remaining sanctuaries of unique wildlife (Onosode, 2001). It is indeed a region of vast human and natural resources.

1.1. Brief History of Oil Exploration Activities in the Niger-Delta

Oil exploration activities in the Niger-Delta dates back to the first decade of the 20th century when a German Oil Company prospecting for bitumen in the coastal parts of Ayetoro in present day Ondo State started. The company made little progress until World War I started. They did not return after the war. In 1937, the Shell d'Arcy Company (present day Shell Petroleum Development Company) started further activities in the Okigwe-Owerri-Aba-Port Harcourt axis of Eastern Nigeria. The first commercial oil

production and export eventually were from the oil fields of Oloibiri in today's Bayelsa State.

Beginning with a daily production rate of just 5,100 barrels of oil per day (bopd) in 1958, production rose steadily such that by independence (1960), the export level of 17,000 bopd had already been reached. Over the years after independence and the Nigerian Civil War, production rose to over 2.0 million bopd. This was mainly as a result of the impressive global demand and upbeat price situation culminating in the oil boom, which started in 1973. Production today averages 2.2 million bopd, but actual figures now depend on many internal and external factors, including Organization of Petroleum Exporting Countries (OPEC) quotas. Oil production is predicted to grow faster over the successive years with other companies like Chevron, Mobil Producing, Texaco Nigeria, Agip Oil, Elf Petroleum, Conoil, Sun Oil and Oando amongst others joining the league of oil companies involved in crude oil exploration in the Niger-Delta.

1.2. Reserve Base and Production in the Region

In 1959, the crude oil reserve base of the country was a modest 25 million barrels. In 2006, it was estimated to stand at nearly 35 million barrels with the government targeting 50 million barrels in subsequent years. Exploration and production activities are mainly concentrated in the onshore and offshore parts of the Niger-Delta region. Although substantial funds have been committed over the years into the prospecting for oil and gas in the Upper Benue and Chad Basin areas of the country, commercial quantity has not been struck in these areas. Many deepwater offshore fields recently discovered are expected to come on stream in the years ahead (Onuoha, 2004). Apart from crude oil, Nigeria also has vast reserves of natural gas in the Niger-Delta. For every cubic metre of oil extracted, there is an equivalent of 187 cubic metres of natural gas. These vast reserves make Nigeria the 3rd most productive nation among OPEC countries, while ranking ninth on the global scale with approximately 2.8% of world production (Jones, 1998).

Crude oil production in Nigeria averaged 2.332 million barrels of oil per day (bopd) in 1997. The average for 1998 and 1999 were 2.13 and 2.153 million bopd. The OPEC quotas were mainly accountable for production cuts in 1999 to 1.89 million bopd but which was hiked to 2.2 million barrels in 2004. Oil forms the mainstay of the Nigerian economy with the sector providing Nigeria with 90% of her foreign exchange earnings, 80% of her gross domestic product (GDP) and 96% of the National Budget. Some oil producing states have their internal revenues solely generated from derivations from the oil trade.

However, the Niger-Delta from which the oil is obtained suffers environmental degradation due to the oil exploration activities. These activities creates harmful effects on the components of the environment namely air, water, soil and living organisms. Humans as well as domestic animals are affected by the prospecting, exploration and exploitation of

crude oil and associated gas.

1.3. Oil activities in the Niger-Delta

The oil industry in Nigeria is mainly confined to the onshore and offshore parts of the Niger-Delta. The industry is usually considered to be in two distinct classes:

1.3.1. The Upstream Sector

The upstream sector refers to activities in oil exploration and production that are carried out within or around the oil wells. These activities include prospecting (searching for oil deposits in commercial quantities), production (actual pumping of the discovered oil out of the Earth) and transportation (moving the unrefined crude oil to the refineries).

1.3.2. The Downstream Sector

The downstream sector of the oil industry involves the refining of crude oil into various products like petrol, diesel, kerosene, naphtha (to mention a few) and the transportation of refined products to consumers by pipelines, sea, road, tankers and rail tankers.

Activities in these sectors (upstream and downstream) have adverse effects on the flora and fauna of these oil-rich areas. These negative effects and their remediation form the basis of this review.

2. Effects of Oil Activities on the Environment

2.1. Oil Pollution

According to the World Health Organization, the environment is considered to be polluted when it is altered in composition or conditions directly or indirectly as a result of the activities of man so that it becomes less suitable to some or all of the uses for which it would be suitable in its natural state. Activities in the oil industry exposes the entire community to ever increasing environmental contaminants, which leads to pollution of air, land and water thereby rendering them unsafe for human use (Fekumo, 2004).

The disastrous effects of oil pollution on the environment have been proved beyond reasonable doubt. It has been confirmed both internationally and nationally that even with proper planning, design and implementation of correct procedures and personnel training, the development of advanced technology and careful precautions, accidents seem to occur periodically in the drilling for oil (Doust and Huang, 1992; Ofurhie, 2001). All activities of the oil industry such as prospecting, production and refining have been found to have negative effects on the environment. Oil spillages, deforestation, acid rain, noise pollution and others are some of the effects of oil activities that are highlighted in the following sections.

2.2. Specific Environmental Effects

2.2.1. Prospecting

Prospecting activities involve the searching for oil in possible sites. This is the first stage in the exploration for crude oil. These activities usually results in physical noise, electrical/electronic and chemical pollution with devastating effects.

2.2.2. Physical Pollution

This became obvious in the early 1960s when surveyors started clearing virgin forests and swamps. During the preparation of the well site, a lot of trees are cut down, which result in disturbance of terrestrial ecosystems. The supply of timber, which is useful in building houses, construction and other commercial activities, greatly reduced so that the income from these resources is also reduced. Marked deforestation will also lead to exposure of soil surfaces, which will lead to erosion and washing away of the top soil principally by rain. The nutrients in the soil are reduced as well as reduction in agricultural activities.

2.2.3. Noise Pollution

During prospecting, geophysicists shoot their geophysical lines to locate specific hydrocarbon traps and oil wells. Seismic technology is the most reliable and widely used exploration tool in the oil industry. It involves the creation of seismic waves at the subsurface and the recording of their times of arrival at specific locations. Explosives and fire electrical devices are employed in this process and in most cases have caused the migration of fauna. The affected environment has reduced agricultural potentials because of the reduction of animal waste that might have served as fertilizers and manure for enriching the soil. The noise pollution resulting from oil production affects both man and animals alike. Since production is a continuous process, the effect of noise is an ongoing and long lasting one. Noise also results from the vibrations and mechanical movement of components of the drilling rig and other equipment.

Light and heat pollution results from gas flaring activities which forms a basic problem in the Niger-Delta. Flaring of gas alters the environment and contributes to global warming, acid rain and other sundry negative environmental effects (Ogbuigwe, 2001).

2.2.4. Chemical Pollution

Prospecting results in the destruction of topsoil and the infiltration of chemicals into the aquifers. The net effect of prospecting activities has been the gradual environmental degradation and alteration of the ecosystem of the area such as the total destruction of the virgin mangrove forest in Igbokoda area of Ondo State in 1988/1989 (Abulu, 2001 and Onuoha, 2004). Oil production processes usually pollute the environment through the dumping of chemicals, drilling mud and oil around wellheads. Valve failure around flow stations and material failure along pipelines are regular sources of pollution. This occurs in both offshore swamps and land areas but the more devastating effects are noticeable in the

swamps. Here, the channels and stagnant water bodies are covered by oil and oil-associated chemicals. As a result, the ecosystem is severely damaged since fish, birds and other animals in the vicinity are killed or scared away leading to loss of natural animal habitats and sanctuaries. Thus, chemical pollution destroys the environment, truncates the food chain and has a lasting effect on the health of animals and humans in the community

2.2.5. Oil Transportation

Crude oil is transported by pipelines and tankers and could result in pollution as follows. Transportation by pipelines over land or through the sea is a veritable source of pollution resulting from either seepage or leakage, breakage of pipes due to accidents or material failure and sabotage or vandalization of pipeline facilities that is a common occurrence in the Niger-Delta. Pollution resulting from pipelines could be slight or massive depending on the quantity of oil spilled. However, the direct physical, chemical or fire damage caused by the effects of this pollution is always devastating and often alters the ecosystem on a permanent basis.

Transportation of gas, crude oil and associated products could be by land (road or rail) tankers, or by water (sea) tankers or super tankers. The pollution resulting from these tankers could be slight discharges from small quantities arising from washing out of tankers containing crude oil into the water bodies or heavy discharges from ship accidents such as the Armoco Cadiz spillage of 1979 and Exxon Valdeze spillage of the 1980s. The net result of the pollution is the same in which fauna and flora are totally destroyed resulting in irreparable damage to the ecosystem.

In the downstream sector, refined products cause less damage than the heavy crude but nonetheless leaking pipelines and tanker collisions can lead to loss of lives due to the combustible nature of refined petroleum products. Spent oils such as used engine oils and naphthalene often result in contamination of the environment due to indiscriminate dumping. These oils degrade farmlands, pollute water bodies and block drainages thereby resulting in reduction of agricultural, fishing and environmental activities.

Ukpong (2001) investigated the Niger-Delta Ecosystem at various locations from the viewpoint of sustainable agriculture, fishing and environmental quality. The study showed a high level of degradation in areas of oil exploitation and the resultant effects on both plants and animals. This point to the fact that communities in which oil activities take place are subjected to environmental abuse and therefore needed remediation.

3. Ecological Effects of Oil Activities on Flora and Fauna in the Niger-Delta

Ecological disequilibrium occurs when the natural factors of the environment are modified by man in the course of

resource exploitation (Ukpong, 2001). The damage to the fragile Niger-Delta ecosystem occurs due to indirect modification as a result of petroleum exploitation. Since the late 1950s, environmental deterioration has increased proportionately to increase in totality of external surroundings of man and other forms of life are not excluded from the environmental perturbation that has replaced the natural dynamic equilibrium situation in the Niger-Delta ecosystem.

3.1. Ecological effects of Oil Exploration on Plants and Economic Crops

3.1.1. Deforestation

During the preparation of oil sites for exploitation, viable economic trees are cut down. This leads to a decrease in the supply of trees or timber for building houses, constructing bridges and other wood related commercial activities. The removal of these trees results in the leaching away of topsoil due to exposure of soil surfaces. The nutrients in soils found in this environment are reduced and culminates in a marked reduction of agricultural activities. Deforestation also results in erosion due to the direct downpour of rain on the unprotected soil in the Niger-Delta.

3.1.2. Damage to Farmland

Oil spillage at exploration sites and along the pipelines will result in damage to farmlands. There is destruction of the topsoil, which supports plants and allows the infiltration of chemicals into the aquifer. Drilling activities also result in the scraping of the topsoil. Depletion of essential nutrients from the ground will lead to abnormal plant growth which culminates in reduction of production output.

3.1.3. Water Salinization

Water salinization may be caused by disposal of industrial wastes and oilfield brines. This disturbs the use of clean water particularly for irrigation of sensitive crops. The loss of fertile agricultural land and reduced crop yields caused by water shortage and oil salinization of irrigated areas destroyed the livelihood of whole communities, some of which depend solely on agriculture as a means of survival.

3.1.4. Hydrocarbon Pollution of Soils and Air

Some parts of the Niger-Delta such as Ifie, Warri and Ibeno were studied by Ukpong (2001) on pollution of soils meant for crop cultivation. These areas were chosen due to the continuous activities of major oil exploiting companies in the region. Expectedly, yields were low in affected areas.

During exploration for crude oil, dynamites shot into the ground cause uncontrollable gushing to the surface. The flow usually occurs along gradients into creeks or basin wetlands where vegetation is starved of air as anaerobic conditions are created. Where soils are polluted by hydrocarbons, soil organisms are destroyed, decomposition is slowed down, anaerobic conditions are created due to blocking of soil pores and nutrients are depleted. As a result of these, there tends to be a decrease in soil nutrient values as pollution becomes more severe. Increase in pollution leads to decrease in

production output of food and cash crops and an overall reduction in financial earnings.

Atmospheric pollution arising from gas flaring also affects the soil as rain passes through the atmosphere to soil surfaces. Considerable volumes of petroleum associated acids also find their way into the soil and water channels and affect viable plant growth.

3.2. Ecological Effects of Oil Exploration on Man and other Organisms

One of the routine soil and water quality parameters in the Niger-Delta is hydrocarbon. Ukpong and Akpan (2001) investigated the Total Hydrocarbon (THC) levels in some water bodies in the Niger-Delta and came up with the following results.

Table 1. Total Hydrocarbon (THC) values in Water Samples from Selected Areas in the Niger-Delta

Location	THC (ppm)
Warri River	150,000
Ugbodede Creek	18,000
Ogune Creek	20,000
Edjeba River	60

The results show that hydrocarbon pollution is high and spreads faster in tidal areas. This spread can be phenomenal particularly if the source is offshore and the current is onshore in the direction as is usually the case along the Niger-Delta shoreline. In these polluted waters, sediment and mangrove mud becomes impregnated with hydrocarbons far from the pollution source and the effects include destruction of fish spawning grounds, decline in plankton that fish feed on and destruction of fishing as a profession. Human health in these areas deteriorates proportionately to the level of water pollution. Gas flaring has also been shown to cause infertility problems due to the heat emitted and respiratory problems due to the toxic substances that they breathe in.

Other health effects of oil pollution on the community and workers include excessive heat and colds, falls from tall heights, disability from fire and explosion, dermatitis from improper handling of spillage materials, respiratory disorders and carcinogenesis.

3.3. Remediation of Affected Sites

Proposed remediation of affected sites include clean-up programs and remediation. In the context of the environment, remediation implies attempts to restore by deliberate action, the natural equilibrium condition that has been destroyed (USEPA, 2000; Ukpong, 2001; Victor and Esin, 2005). Arguably, the Nigerian oil industry is currently immersed in an era of sustainable development, which is consequent upon the growing awareness on environmental issues and concerns. Environmental degradation due to hydrocarbon contamination has over the years been an integral part of exploration and production activities in the Nigerian oil and gas industry. The most significant large-scale entry of crude oil and associated pollutants into the ecosystem is through

accidental spills and gas flaring. Efforts have been made by the major oil companies in the Niger-Delta to cushion the effects of environmental pollution through various innovative environmental management systems and approaches. These approaches have proved effective both in the land terrain and in the swamps with much successes recorded in offshore spillage cleanups.

4. Conclusion

Environmental pollution and the adverse effects on the host communities of oil exploration sites in the Niger-Delta is an important issue that requires urgent and prompt attention in view of the fact that petroleum production forms the major natural-based resources on which the country depends. Policy makers of the various oil exploration companies should realize that there is need to protect the health, safety and welfare of these communities.

The communities and the inhabitants have to be well protected and some of the health and safety measures which members of the company staff benefit should be extended to members of the host community. Also these companies must adhere to relevant government legislation aimed at protecting lives and property in their areas of operation to maintain and ensure minimal environmental degradation. Reduction of morbidity and mortality resulting from exposure to environmental pollutants and improvement of the overall productivity of the communities will result in a boost for the country's economy.

Acknowledgement

Literature searches by Mr Ikuomola Olumide Temitayo are hereby acknowledged.

References

- [1] Abulu, J.O. (2001). Environmental regulation to oil production and transportation. Proceedings of International Seminar on the Petroleum Industry and Nigerian Environment
- [2] Akintola, F.A. (1982) Geology and Geomorphology, Nigeria in Maps, In: Barbour K. M et al. (Eds.), Hodder and Stoughton, London, 1982, p. 209.
- [3] Congressional Research Service (CRS). (2008) Nigeria: Elections and issues for Congress Updated. RL33964. Nigeria: Current Issues. Retrieved from www.crs.gov
- [4] Doust, H.G and Huang, J.C. (1992). The fate and transport of hazardous chemicals in the subsurface environment. *Water Science Technology*.25 (1):169-176
- [5] Fekumo, J.F. (2004). Oil pollution and problems of compensation in Nigeria. Environmental guidelines and standards for the petroleum industry in Nigeria.
- [6] Jones, B.S. (1998). Oil in Navigable Waters Act.CAP 337.LFN 1999
- [7] Nwokolo, H. (2001). Shell perspective on community issues and sustainable development. Proceedings of International Seminar on Oil pollution and environmental management, Abuja.
- [8] Ofurhie, M.A. (2001). Environmental regulations in the upstream and downstream sector of the oil and gas industry in Nigeria. *Environmental Policy and Law*. Vol.28:2 (May, 2001)
- [9] Ogbuigwe, A. (1995). Nigerian Environmental Law and the increasing challenges of Natural Gas Exploration. Manual of Petroleum Laws compiled by Petroleum Inspectorate. FMPR, 1995
- [10] Olawoyin,R., S. Oyewole, C.W. McGlothlin, B. Heidrich, S.O. Abegunde, A. Nieto, and O.T. Okareh (2014). Characteristic Fingerprints of Polycyclic Aromatic Hydrocarbons and Total Petroleum Hydrocarbons Pollution in Petrochemical Areas. *International Journal of Environmental Pollution and Solutions* (2014) Vol. 2 No. 1 pp. 1-19
- [11] Onosode, G.O. (2001). Oil pollution and environmental management: Issues Arising. International Conference on oil pollution and environmental management, Abuja
- [12] Onuoha, K.M. (2004).Oil and gas exploration and production: Recent developments and challenges ahead. *Environmental Policy and Law*. Vol.29:12 (March, 2004)
- [13] Powell, C.B, Ibiebele, D.O., Bara, M., Dutkwicz, B., Isoun, M.O. (1985) Oshika Oil Spill Environmental Impact; effect on Aquatic biology. NNPC/FMHE International Seminar on petroleum industry and the Nigerian Environment, (pp. 168 – 178.). Kaduna, Nigeria
- [14] Rahaman, M.A. (1976) Review of the basement geology of Southwestern Nigeria: In: *Geology of Nigeria*, edited by Kogbe, CA, Lagos: Elezabetha Publishing Company
- [15] Ukpong, E.I. (2001).Incipient Ecosystem damage in parts of the oil fields of the Niger-Delta, Nigeria: Implications on a model for sustainable agriculture, fishing and environmental quality. Heinemann Publishers, Ibadan.
- [16] Ukpong, E.I and Akpan, O.F. (2001).Comparison of synthetic surfactants and biosurfactants in enhancing biodegradation of hydrocarbons in the Niger-Delta. Heinemann Publishers, Ibadan.
- [17] USEPA (2000). Engineered approaches in situ bioremediation of chlorinated solvents: fundamentals and field applications.EPA-542-R-00-008, Cincinnati, OH
- [18] Victor, S.A. and Esin, A.A. (2005). Remediation / Corrective measure of hydrocarbon impacted sites in local swamps of the Niger-Delta using the soil purge and soil strip techniques. International Conference on Energy, Environment and Disasters.USA. (Charlotte)