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Petroleum Spills and Accidental Discharges in the Niger Delta- A Literature Review

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Abstract
This study examines the impact of petroleum spills and accidental discharges in the Niger Delta. Its adverse effects as seen on the terrestrial ecosystem, shorelines, aquatic ecosystem, our coral reef, destruction of our mangroves, depletion and extinction of many other sea life forms. Oil spillage, which often results from operational discharges of petroleum into the environment, is now a global issue that has been since the discovery of Crude Oil. The Niger Delta has experienced several disasters from oil blowouts; according to estimates, over 2,567,960 barrels of crude oil have been spilt in 5733 incidents in the Niger Delta from 1976-2000 549,060 barrels were recovered while 1,820 barrels were lost to the environment. Contamination of the marine ecology associated with oil spills and occupational discharges of petroleum, if not effectively checked, can lead to degradation of the mangrove forests area, destruction of ecology, rapid decline in the fish and agricultural produces that are central to the livelihoods of local communities.

Keywords: *Petroleum spills; Marine ecosystem; Niger Delta Region; Environmental; FEPA.*

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Introduction

The recent effects of large scale spills and oil pollution in the coastal areas are well documented, and most of the terrestrial ecosystems and shorelines in the oil-producing communities are often impacted (Blumer, 1972). For example, defoliation and mortality of the mangroves have been observed in swamps affected by oil spills (Linden *et al.*, 1980). The effects of oil pollution resulting from exploitation and exploration on the diversity and functioning of fish and other sea forms communities in the Niger Delta have been reported (Luiselli *et al.*, 2003). When there is a discharge onshore or near shore, the earth and other terrestrial ecosystem components are inevitably affected (Osuji *et al.*, 2007). Contamination of the marine ecosystem associated with oil spills and accidental discharges of petroleum, if not effectively checked, can lead to degradation of the mangrove forests, destruction of ecological forms, gradual decline in the fish and agricultural produce that are central to the livelihoods of local communities (Ite, et al., 2013).

Oil spillage, which often results from accidental discharges of petroleum and other of its constituents into the environment, is a global concern that has materialized since the excavate of Crude Oil. This can be seen in Nigeria and other countries where exploration and exploitation occurs. For example, the Niger Delta has experienced several disasters from oil blowouts; according to estimates, over 2,567,960 barrels of crude oil has been spilt in 5733 incidents in the Niger Delta region from 1976-2001, and about 549,060 barrels were able to be recovered while 1,820 barrels

were lost to the Environment (Edoho, 2008). Furthermore, the causes of unreported spills by some oil exploration, exploitation, production and manufacturing companies may be associated with the Nigerian National Petroleum Corporation (NNPC) classification guidelines whereby spillage are classified into minor, medium and significant disasters. In past years, major oil spills have attracted global attention and created awareness due to the associated environmental, human health and environmental risks and damages that result from such spillages. The primary sources of the oil spill which has caused land pollution, water (aquatic) pollution, air soiling in the Niger Delta are equipment failure, oil blowouts from the flow stations, leakages from the aged and corroded network of the pipelines, operational mishap, sabotage and vandalization of the oil pipelines by the local militant groups (Ogri, 2001). However, oil spills resulting from the vandalization of channels either due to civil disaffection with the political processes or as a criminal activity causes severe contamination of the environment, which can be seen in our flora and fauna (Nwilo *et al.*, 2006). Oil spills from anthropogenic and natural sources and their production discharges in the Niger Delta processes have disastrous effects on land, freshwater swamps and the marine environment, and potential threats to human health and wellbeing in the affected host communities (Petters, 2013).

Drilling discharges

Before the institution of statutory laws and regulations in the 1970s, the major petroleum-derived wastes such as produced water, spent drilling needs, drilling cutting and wastes that require handling during site abandonment were commonly discharged into coastal waters in the shorelines, swamps, and underlined evaporation ponds (Kharaka *et al.*, 2003) and (Petters,2013).

Effect of petroleum-derived waste on the marine ecosystem

The aquatic ecosystem houses the destination for most contaminants in the habitat (Saliu *et al.*, 2014) with numerous organic and non-organic pollutants of municipal waste, industrial, agricultural and mining industrial activities (Lenartova *et al.*, 1997). Crude oil pollutant is among the most essential and abundant class of contaminants found in the aquatic environment; such pollutants affect the integrity of the ecosystems and affect the physiological functions of animals and humans as consumers (Perez-lopez *et al.*, 2002).

Marine and coastal wildlife exposed to petroleum-derived waste may suffer immediate health problems and long-term changes to their physiology and behaviour. In small doses, pollutants can cause interim physical harm to fauna. The following are types of trauma which include skin irritation, altering the immune system, reproductive or developmental damage and liver disease. However, when large quantities of pollutants permeate a body of water, execrable effects such as cancer turns more likely, and direct mortality of wildlife can be widespread (Ben-David *et al.*, 2000).

The Niger Delta Region of Nigeria

The Niger Delta region is found at the apex of the Gulf of Guinea on the West Coast of Africa and on Nigeria's South-South geopolitical zone (Hack *et al.*, 2000; Doust., 1990). The Niger Delta, which is home to about a 31million people, occupies a total land area of approximately 75,000km2 and makes up 7.5% of Nigeria's landmass. The Niger Delta region consists of 9 Oil Producing States, including Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Ondo, Imo and Rivers, alongside 185 LGA (Local Government Areas). This Niger Delta region cuts across over 800 oil-producing communities with an extensive network of over 900 producing oil wells and numerous petroleum production-related facilities (Osuji *et al.*, 2004). The Niger Delta region can be divided into two major areas: the tropical rainforest and the mangrove forest, and there are dominantly found in the northern part of the Niger Delta region. Mangroves are a group of trees and shrubs that live in the

coastal intertidal zone**.** About Eighty percent (80%) of different species of mangrove trees exist. These trees grow in low-oxygen soil areas, where slow-moving waters allow fine sediments to accumulate.

Mangrove forests and swamp is known for regular saltwater inundation lies at the centre of a complex and sensitive ecosystem which is very to the local economy and accommodates essential flora and fauna (Ugochukwu *et al.*, 2008). Also, Bellama (1999) indicated that petroleum provides most of the organic chemicals used to make everything from adhesives, analgesics and antifreeze to zip-lock bags and zippers. The Niger Delta, the world's largest, is the widest part of Nigeria in terms of petroleum resources and numerous natural ecosystems that support many terrestrial and aquatic fauna species. Over the past five decades, about 1,182 exploration wells have been exploited.

Historical perspective of oil exploration and production in the Niger Delta region of Nigeria

Petroleum resources exploration and production in Nigeria date back to 1908 when German land surveyors for the Nigerian Bitumen Corporation began exploring for Tar Sand deposits in the South and Western part of Nigeria. These pioneering efforts ended swiftly with the upsurge of World War I in 1914, and who must note that exploration of petroleum resources did not begin until 1938, when Shell Darcy, a consortium of the Iranian Oil company (later British Petroleum) and Royal Dutch Shell) was granted sole ex-gratia right over the entire country. However, World War II (1939-1945) call to order the initial oil exploration activities by Shell D'Arcy.

Oil exploration in Niger Delta resumed in 1946 after World War II, and shell D'Arcy drilled several oil exploratory wells in 1951. At the early stage, shell D'Arcy later Shell-British Petroleum) enjoyed a monopoly of oil exploration for a considerable long time (1938-1955). After that, Mobil producing Nigeria Ltd, a subsidiary of American Seconny-Mobile Oil Company, obtained the license to explore crude oil and operations in Nigeria began in 1955 with a nomenclature Mobil Exploration Nigeria incorporated (incorporation as Mobil producing Nigeria took place on June 16, 1969). who later discovered the first commercial oil discovery in the tertiary Delta at Oloibiri field in January 1956 by Shell D'Arcy, and a second oil field at Afam (Haack *et al.*, 2000; Vassiliou., 2009). In February 1958, Shell British Petroleum which has now changed its name to Royal Dutch Shell, started exporting crude oil produced from Afam community and Oloibiri oil fields (Pearson, 1970); the giant Bomu oil field, which has appraised ultimate recovery (EUR) of 0.311 billion barrels of oil and a total of 0.608billion of barrels of oil equivalent (BBOE) including gas, was discovered South-East of Port Harcourt, Rivers State in 1958 (Vassillou, 2009).

The oil sector began to play a vital role in shaping the Nigerian economy and political vesting of the country in the early 1960s. When Nigeria became an independent nation on October 1 1960, Shell started to relinquish its acreage and converted its exploration licenses into prospecting licenses that allowed development and production. (Vassilous, 2009; Bamberg, 2000) following the increased dominance of the Nigerian economy by the petroleum sector, which abandoned the sole concession policy and introduced an exclusive exploration right to encourage other Multinational Oil Companies to accelerate petroleum exploration + exploitation, and production. Other Multinational oil-producing companies joined oil and gas exploration in Nigeria. Amoseas Gulf Oil Company in 1961, Texaco Overseas Nigeria Petroleum Company Unlimited in 196, Societe Africaine des Petroleos (SAFRAP) in 1962 (which later became ELF Nigeria Limited in 1974), T Azienda Generale Italiana Petroli (AGIP) in 1962, ENI in 1964, Tennessee Nigeria Limited (Tenneco) in 1962, Pan Ocean Oil Corporation in 1972 and Philips Oil Company in 1964 Most of these multinational oil companies recorded considerable oil and gas exploration and production successes in both offshore and onshore fields in the Niger Delta region.

The Federal Government of Nigeria saw the need to have a department of its own, which led to the median Department of Petroleum Resources (DPR) inspectorate in 1970. Nigeria later joined

the Organization of the Petroleum Exporting Countries (OPEC) in 1971 with valid account til dates. As a result, the Nigerian National Petroleum Corporation (NNPC) was established in 1977 with the responsibility of taking control of the country's petroleum industry, Nigeria nationalized Bp's holding entirely in 1979, and Shell BP became Shell Petroleum Development Company of Nigeria (SPDC) (Genova, 2007).

Several other oil companies have joined in exploration, exploitation, and production over the past decades; SPDC has the largest average in the country. It produces 39 per cent of the nation's oil and remains the primary producer in Nigeria's petroleum industry. The Niger Delta protectorate is richly endowed with 31giant oil and gas wells. Each has an estimated quintessential recoverable oil of more than a 500million barrels and produces over 1 million barrels of exploration in; the nation's total production of a 2.1million barrels per day has been explored. Currently, there are over 18 multinational oil companies which are involved in oil and gas exploration and production in the Niger Delta (Poindexter, 2008) and the major players include Dutch Shell, Exxon Mobil, Eni/AGIP, Total Fina Elf and US-based Chevron Texaco. 17 Giant oil and gas production fields are located offshore. Some examples include Bonus, Meren, Abo, Bonga, Assan, Ubit, Agbami, Oso.

Environmental Regulation of Gas and Oil Exploration in Nigeria

In the Niger Delta Area of Nigeria, many approaches have been developed to protect the environmental impact of oil exploration and natural gas exploration and production operations in the Niger Delta region. Most statutory laws and regulations provide the framework for petroleum resource exploration and production in Nigeria. However, only a few of these environmental policies give guidelines on petroleum pollution issues. The emergence of the Niger Delta as one of Nigeria's most ecologically sensitive regions has led to the institutionalization of many statutory laws and environmental regulations (Esie, 2018).

Nigerian Federal Government has disseminated constitution and regulations towards oil and gas exploration and production operations on both onshore and offshore oilfields, which could be controlled by systems of limits such that it targets to reduce the associated environmental impacts, especially in the immediate environment. Some of the related ecological constitutions and regulations in the Oil and Gas Sector including Oil in Navigable Waters Acts (1968), Oil Pipelines Act 1956 (amended in 1965), Mineral Oils (Safety) Regulations (1963), Petroleum Acts (1969), Associated Gas Re-injection act (1979), Federal Environmental protection Agency (FEPA) Act (1988), The Natural policy on the environment, 1989 (revised in 1999), Natural Environmental Protection (Effluent limitations) Regulations (1991), Department of Petroleum Resources (DPR) Environmental Guidelines, Environmental Impact Assessment (EIA) Act (1992) etc.

In the Niger Delta region of Nigeria, the involvement of communities in the environmental decision-making process is a new normal which is relatively ineffective with little or no sustainable development goal. Although, over the past fifty years, the multinational oil companies operating in the Niger Delta region has performed below standard in adopting sustainable exploration and production practices due to increased costs of complying with environmental regulations is now in place, ecological pollution associated with oil and gas exploration and production activities has continued to persist under these laws for several reasons.

The establishment of the federal environmental protection agency (FEPA) in 1988 significantly changed the legal status quo of environmental regulation in the Nigerian petroleum industry. Under the 1988 Act, which imposed parities and enforcement mechanisms. Multinational Oil corporations could be held liable for clean-up costs and restoration in the environment if a strict susceptible principle is practised in the Niger Delta region and Nigeria.

Therefore, unsustainable oil exploration and production practices and poor environmental management practices have impacted the atmosphere, lithosphere, hydrosphere, sediments,

biological diversity and sustainability of the natural ecosystem in the Niger Delta region for several decades; who must curtail this for the sake of our shared future.

Direct effects of petroleum-derived waste on the marine ecosystem

(1) Absorption: Absorption of petroleum-derived wastes through the skin can damage the liver and kidneys, cause anaemia, suppress the immune system, induce reproductive failure, and in extreme cases, kill an animal (Wilson *et al.,* 1993). Exposure to petroleum-derived waste may initiate burns or cause contagiousness to the skin of some species; fish and sea turtle embryos may grow more slowly than average, leading to lower hatching rates and developmental impairments (Jensenn, 1994).

(2) Inhalation: Inhalation of volatile chemicals freely occurs among those species or lifeforms of wildlife that need to take in of air. Inhalation of these harmful substances can cause respiratory smarting, emphysema, irritation, or pneumonia. Nematodes, dolphins, whales and sea turtles all come to the surface to inhale periodically and are susceptible to this risk.

(3) Ingestion: Ingestion of petroleum-derived waste can cause gastrointestinal irritation, ulcers, bleeding, diarrhoea and digestive complications (Soetan *et al.,* 2013). These complications may hinder the ability of animals to digest and absorb food which ultimately leads to reduced health and fitness (Ugochukwu, 2008). Ingestion may occur at multiple levels of the food chain. For example, plant-eating (Herbivorous) wildlife, such as sea turtles, may consume vegetation that has been coated with kerosene particles. Animal-eating (Carnivorous) wildlife, such as shorebirds that feed on clams, mussels or worms buried in the wetlands area, may consume prey organisms that have been exposed to oil sediments washed onto the shoreline. In addition, top predators may become endangered by large quantities of pollutants in the environment through bioaccumulation (the increased concentration of toxins found at higher levels of the food chain (Van-der Oast *et al.*, 2003). These are the major primary pathways of the direct impact of kerosene/crude oil on fish health.

An indirect effect of petroleum-derived waste on the marine ecosystem

Petroleum products like kerosene can indirectly affect aquatic lives by causing changes in behaviour.

(1) Increase in foraging time: This may be required to meet the energy needs of the fish. Animals (fish) may need to make longer trips to find food in unfamiliar areas, and they may need to forage on less preferred food that takes more time to acquire, or that is hard to digest after consumption. A decrease in diet diversity due to lower food availability may reduce overall health. At the same time, the energy requirements of these fishes may be increased due to the physiological challenges brought about by exposure to the petroleum-derived product (kerosene) (Alonzo-Alvarez *et al.*, 2007).

(2) Disruption of life cycles: This may become apparent if particular life forms are more susceptible to the effects of petroleum-derived wastes than others. Eggs, larvae, and juveniles of many species are more vulnerable to the harmful impacts of pollutants than adults. Furthermore, if a particular life stage of species is decimated, the ability of the species to rebound after the spill is significantly reduced (Alonzo-Alvarez *et al.*, 2007).

(3) Changes in foraging locations: This mainly occurs among herbivorous fishes. For example, suppose a spill causes direct mortality to the food resources of a particular species. In that case, many individuals of this species will need to relocate their foraging activities to unaffected regions by the spill. It has increased competition for remaining food sources in more localized areas. This congregation can be especially problematic for rare species, which may become more susceptible to predation or future catastrophic events. At the same time, a large proportion of the population forages on a few concentrated patches (Van-der Oast *et al.*, 2003).

The African Catfish (*Clarias gariepinus*)
Scientific Classification
Kingdom: Animalia
Phylum: Chordate
Class: Actinopterygii
Order: Siluriformes
Family: Claridge
Genus: *Clarias*
Species: *Clarias gariepinus*
(Burchell, 1822).

Natural distribution of the African catfish
Clarias gariepinus, or African sharptooth catfish, is a catfish of the family *Claridge*, the air-breathing catfishes. They are found throughout Africa and the Middle East and live in freshwater lakes, rivers and swamps, and human-made habitats, such as oxidation ponds or urban sewage systems. The African sharptooth catfish was introduced worldwide in the early 1980s for agriculture purposes. As a result, it is found in countries far outside its natural habitats, such as Brazil, Vietnam, Indonesia and India.

Description of the African catfish
The African Catfish (*Clarias gariepinus*) is a large, eel-like fish, usually of dark grey or black colouration on the back, fading to a white belly. In Africa, this catfish has been reported as being second in size only to the vundu (the largest freshwater species in Southern Africa) of the Zambian waters. However, the Fish base suggests the African catfish surpasses that species in maximum length and weight (Froese *et al.*, 2014). *Clarias gariepinus* has an average adult length of 1-1.5m (3ft 3in-4ft 11in). It reaches a maximum height of 1.7m (5ft-7in) and can weigh up to 60kg (130lb) (Froese *et al.*, 2014). They have slender bodies, flat bony heads, notably more matte than the genus *Silunus*, and broad, terminal mouths with four pairs of barbels. They also have large accessory breathing organs composed of modified gill arches that help them live and stay alive for hours outside their natural home (water).
The African catfish is a nocturnal fish like many catfish. It feeds on living and the dead, animal matter because of its wide mouth. It can swallow relatively large prey whole. It has been known to take large water birds such as the common moorhen. It is also able to crawl on dry ground to escape drying pools and can survive in shallow mud for long periods, between rainy seasons (Anoop *et al.*, 2009)

Economic importance of African catfish
Fish farming is the sub-set of agriculture that focuses on rearing fish under controlled conditions for economic and social benefit (Anthonio *et al.*, 2002). The food and Agriculture Organization (2000) stated that fisheries products represented a significant source of export revenue for developing countries, amounting to over 20 billion US Dollars per annum in the late 1990s. The values obtained from the exports of meat, dairy, cereals, vegetables, fruit, sugar, coffee, tobacco and oilseeds in 1997 from developing countries (International Trade Centre, 2002) exceeds the level today. However, FAO (2007) estimated that Nigeria imports about 560,000 tonnes of fish, estimated at $400 million annually, while Nigeria's annual domestic fish supply stands at about 400,000 tonnes.

Catfish production is essential to the Nigerian economy. It serves as a source of income, reduces the rate of unemployment in the economy and increases the Gross Domestic Product (GDP). In most countries, it fetches a higher price than tilapia as it can be sold live at the market, as they have a market value two to three times that of tilapia (Emokaro, 2010). According to Olagunju *et al.* (2007), it requires less space, time, money and has a higher feed conserving rate. Catfish provides food for the populace, and it allows for improved protein nutrition because it has a high biological value in terms of high protein retention in the body, higher protein assimilation as compared to other protein sources, low cholesterol content and one of the safest sources of animal protein (Anoop *et al.*, 2009). Many fish species are farmed worldwide, but catfish are taking the lead because of their uniqueness. The demand for catfish in Nigeria is unprecedented, so much that no matter the quantity supplied into the market, it would be consumed by ready buyers. It tastes great because of its low-calorie value, low carbohydrate content, high protein content, low in fat, and quick and ease to prepare.

Conclusion

The harmful effects of the exploration and production activities of the Niger Delta region can not be overlooked rather obliged. There's a constant need to check the activities of the Niger Delta region consistently if the hope of our common future must be sustained. The negative effects of accidental discharge on the environment out weight the positive effects in the biotic and abiotic components of the environment. The accidental spills can be checked with the use of effective monitoring tools like imploring artificial intelligence for monitoring and notifying the company of potential spills, especially offshore.

Recommendations

It is crucial that exploration and production sites should be far away from residential areas in order to reduce the effects of harmful chemicals during exploration on health. Oil booms should be consistently used to clean up the sea annually, followed by skimmers or oil scoops to gather and treat the affected parts. Areas where the amount of spill are over 3mm burning in-situ, must be applied. This method can take care of about 98% of the spill on the surface of the water. There should be proper monitoring of exploration and production lines against sabotage; for this to be achieved, the local communities must be settled and carried along in the exploration and production process. Underground pipes should have a reporting sensor to know when there is a linkage. Illegal refining of oil must be stopped and brought into law

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