

EFFECTS OF OIL SPILLAGE ON FISH IN NIGERIA: A CASE STUDY OF NIGER DELTA

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ABSTRACT

This paper examines the effect of oil spillage on fish in Nigeria considering its relatedness to Niger Delta Region. It further isolates types of oil spillage, overview of oil spills in the Niger Delta and causes of the oil spills. It also analysed the effects of oil spillage on fish using descriptive method to obtain logical deductions and sequential presentation of facts from the data obtained to give a clear picture of the problems caused by oil spillage on fish. The environmental and economic effects of oil spills on the livelihood of the people were reviewed. The direct and indirect effects and the factors that influence the degree of impact on fish were discussed. The general socio-economic effect on the fish farmers and poor masses was not left out. Techniques that should be utilized to prevent and control the situation are suggested, and possible recommendations made.

Key Words: Oil spillage, Niger-Delta Region, Effect on fish

INTRODUCTION

Spills are uncontrolled releases of any product including crude oil, chemicals or waste caused by equipment failure, operation mishaps, human error or intentional damage to facilities. The extent of damage depends on what, where and how much has been spilled and how long it remains in the immediate and impacted environment (cf. SPDC, 1997).

High inertia and elasticity are properties expected of a physically and chemically varying ecosystem with an extensive history of pollutant stress. In the case of crude oil releases, especially where the recipient environment is aquatic, the impacts are in the range of unquantifiable damages to fishes and other economically important aquatic organisms, as well as the direct and indirect negative effects on the socioeconomic lives of human settlers whose survival has much to do with the products of aquatic environment (cf. Enujiugha and Nwanna 2004).

When we think of oil spills, we usually think of oil tankers spilling their cargo in oceans or seas. However, oil spilled on land often reaches lakes, rivers, and wetlands, where it can also cause damage. Oceans and other saltwater bodies are referred to as marine environments. Lakes, rivers, and other inland bodies of water are called freshwater environments. The term aquatic refers to both marine and freshwater environments.

When oil is spilled into an aquatic environment, it can harm organisms that live on or around the water surface and those that live under water. Spilled oil can also damage parts of the food chain, including human food resources. Fishes happen to be one of the most important organisms living in an aquatic environment that oil spillage affect extremely. They are very much vulnerable and susceptible to any slight change in their environment (water).

The severity of the impact of an oil spill depends on a variety of factors, including characteristics of the oil itself. Natural conditions, such as water temperature and weather, also influence the behaviour of oil in aquatic environments. Various types of habitats have differing sensitivities to oil spills as well.

Where is NigerDelta?

The Niger Delta Region belongs to the South-South geopolitical zone of Nigeria. The Niger-Delta region is located in the coastal part of Nigeria and this is a waterlogged area as more than eighty per cent of the oil producing communities is on water. It is the most endowed deltas in the world in terms of both human and material resources. Before the discovery of crude oil, agriculture (farming and fishing) was the dominant occupation of the people with fishery as their basic means of livelihood of many of them.

Before the discovery of oil in the region, it was characterized by natural clean long stretch fresh water and healthy water lettuce that add beauty and flavour to the environment.

As of now, oil is the basis of the existence of the Nigerian nation state. In spite of the stupendous wealth that Nigeria has generated from the production and sale of oil, one of the negative externalities from the oil industry is marine pollution occasioned by oil spillage and discharge of effluents. These oil effluents affect the productivities of fish hence this study aim at discussing the effects of oil spillage on Fish in Nigeria using Niger Delta region of Nigeria as a case study.

Objective of study

The aim of this paper is to enlighten readers in the various effects of oil spillage on fish specifically in the Niger Delta of Nigeria. As well as bring into various perspective the mechanism of actions of oil spillage on aquatic organisms especially fishes, occurring in an important, reproductive wetland and marine ecosystem. It will enlighten and sensitize relevant authorities on the problem of oil pollution on fishes within the Niger Delta region of Nigeria with recommendations

that would be made arising from the study, which will help policy makers on future plans. It also hopes to serve as a useful reference material and catalyst that will stimulate future researchers.

LITERATURE REVIEW

The Concept of Oil Spillage and water pollution

Fish is an inexpensive source of protein and an important cash crop in many regions of world and water is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (cf. Bronmark and Hansson, 2005). Water quality is determined by various physico-chemical and biological factors, as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals (cf. Moses, 1983). Many workers have reported the status of water bodies (lentic and lotic) after receiving various kinds of pollutants altering water quality characteristics (physical, chemical and biological). All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase within these limits has adverse effects on their body functions (cf. Davenport, 1993: Kiran, 2010). So, good water quality is very essential for survival and growth of fish. As we know fish is an important protein rich food resource and there has been sharp increase in demand of fish products due to increasing population pressure in this century. Thus to meet the demand of present food supply, water quality management in fish ponds is a necessary step that is required to be taken up.

The study of the environment and the impacts of human activities on natural ecosystems have recently assumed a

worldwide focus. Obviously, man's constant quest to fully utilize the product of the environment has led to the production of wastes in such proportions as to threaten the very existence of certain strategic ecological habitats and directly or indirectly affects human population. According to Sheehan *et al.* (1984), releases into the environment of persistent chemicals lead to an exposure level which ultimately depends on the time the chemical remains in circulation, and how many times it is circulated in some sense, before ultimate removal.

This pollution affects both the renewable and non-renewable natural endowments of the affected areas like the case of Niger Delta. These have resulted in so many chaotic challenges which range from low productivity in both farming and fisheries area (which is the major source of livelihood of people in that region) to youth on-rest situation found in that region.

Spills are uncontrolled releases of any product including crude oil, chemicals or waste caused by equipment failure, operation mishaps, human error or intentional damage to facilities. The extent of damage depends on what, where and how much has been spilled and how long it remains in the immediate and impacted environment (cf. SPDC, 1997). In the case of crude oil releases, especially where the recipient environment is aquatic, the impacts are in the range of unquantifiable damages to fishes and other economically important aquatic organisms, as well as the direct and indirect negative effects on the socioeconomic lives of human settlers whose survival has much to do with the products of aquatic environment (cf. Enujiugha and Nwanna 2004). Types of trauma oil pollution can cause fishes and wildlife animals include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease. When large quantities of oil enter a body of water,

chronic effects such as cancer, and direct mortality of wildlife becomes more likely.

Niger Delta Biodiversity

Niger Delta areas have an ecosystem that can be said to be highly diverse and supportive of numerous species of terrestrial and aquatic fauna and flora as well as human life (Eregba and Irughe, 2009). The Niger Delta has been declared as a key zone for the conservation of the western coast of Africa on the basis of its extraordinary biodiversity (cf. Nenibarini, 2004).

The estimate given by Salau in his work, claimed that in Nigeria there are more than 46,000 plant species of which about 205 are endemic, and approximately 484 plants in 112 families are threatened with extinction as well as many animal and bird species (cf. Salau, 1993). Another estimate is that 24 out of 274 mammal, 10 out of 831 birds and 2 out of 114 reptiles known to exist in Nigeria are endangered (cf. WRI, 1992). The larger population of the Niger Delta survive on services provided by the ecosystem; agriculture, industry, fishing, food, drinking water, wood, shelter, medicine, employment and aesthetics. All aspect of oil exploration and exploitation has adverse effects on the ecosystem and the local biodiversity. Oil exploration by seismic oil companies involves clearing of seismic lines, dynamiting for geological excavation, which affects the aquatic environment. It causes mortality in fauna, turbidity in the water that blockage of gills of the filter feeders in the benthic fauna, reduction of photosynthetic activity caused by the water turbidity that reduces the amount of sunlight penetration (cf. Kadafa, 2012). Oil and gas pipeline have been installed covering 7,000km to enhance the distribution crude oil products to other parts of the country (cf. Onuoha, 2008). The installation of these pipelines involved clearing large areas of habitat to make pipeline tracks. These pipelines run across the rainforests and

mangroves with incidences of leakage and rupture and accidental discharges. These discharges are caused by vandalism, failure of pipeline integrity due to aging and defects in material. Most incidences of the reported oil spillages have occurred in the mangrove swamp forest, which is one of the most reproductive ecosystems rich in fauna and flora (cf. Nenibarini, 2004).

Background of study and Niger-Delta as a Case Study

The major environmental issues in the Niger Delta of Nigeria relate to its petroleum industry. The delta according to Wikipedia covers 20,000 km² within wetlands of 70,000 km² formed primarily by sediment deposition. Nigeria has a coastal line of approximately 85km towards the Atlantic Ocean lying between latitude 4°15' to 4°50' and longitude 5°25' to 7°37' with a land mass of about 28000sq/km area within the coastal region. The surface area of the continental shelf is 46300sq/km (cf. Kadafa, 2012). The coastal areas consist of freshwater swamp, mangrove swamp, beach ridges, sand bars, lagoons marshes and tidal channels. Nigeria has a total land mass of 923,768sq/km; 918,768sq/km being terrestrial land and 13000 sq. /km being aquatic (cf. CIA World Fact Book). The coastal area is humid with a mean average temperature of 24-32°C and coastal area has an average annual rainfall ranging between 1,500- 4,000m (cf. Kuruk, 2004). Nigeria has two large rivers; the Niger-Benue and the Chad River. There are several rivers that channel into the Atlantic Ocean directly, all other flowing waters flow into the Chad basin or into the lower Niger to the sea eventually (cf. Kuruk, 2004). Home to 20 million people and 40 different ethnic groups, this floodplain makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third-largest drainage basin in Africa. The Delta's environment can be broken down into four ecological zones: coastal barrier islands,

mangrove swamp forests, freshwater swamps, and lowland rainforests (cf. Wikipedia, 2016).

Extent of the problem Reports on the extent of the oil spills vary. The Department of Petroleum Resources estimated 1.89 million barrels of petroleum were spilled into the Niger Delta between 1976 and 1996 out of a total of 2.4 million barrels (cf. Vidal,2010) spilled in 4,835 incidents - approximately 220 thousand cubic metres (cf. The Daily Independent, 2010). The Punch Newspaper on February 20, 1991:2 reported a total of 2,796 oil spill incidences recorded between 1976 and 1990, leading to 2,105,393 barrels of oil spilled. The UNDP 2006:181 also reported that between 1976 and 2001, 3 million barrels of oil were lost in 6,817 oil spill incidences of which over 70% of the spilt oil was not recovered (cf. UNDP,2006 and Kadafa, 2012). 69% of these spills occurred off-shore, a quarter was in swamps and 6% spilled on land. Some spills are caused by sabotage and thieves, however most are due to poor maintenance by oil companies such as Shell (cf. Al Jazeera English, 2016) and the recent pipeline bombing.

General effect of Oil exploration in NigerDelta

Oil spillage is a global issue that has been occurring since the discovery of crude oil, which was part of the industrial revolution.

According to Bisina (2006), the oil activities in the area has resulted to situations whereby complete polluted water is bequeathed to the children. Following the discovery of crude oil in 1956 by British Petroleum (now Royal Dutch Shell) at a village called Oloibiri in Bayelsa state which is located in Niger Delta (cf. Onouha, 2008 and Anifowose, 2008), Nigerian have come to exposed to environmental pollution caused by oil spillage with the commercial production that began in 1958.

Studies have shown that the quantity of oil spilled over 50 years was a least 9-13 million barrels, which is equivalent to 50 Exxon Valdez spills (cf. FME, 2006).

Since then, oil exploration has continued resulting into what is termed environmental destruction due to neglect and negative attitude of the multinational companies in environmental management in the area. The world today recognises the significance of environmental sustainability to the development of the nations. In fact, one of the cardinal objectives of the Millennium Development Goals is to ensure environmental sustainability. It then implies that there should be reduction in environmental pollution (cf. Eregha&Irughe, 2009).

Components of Crude Oil

The compounds in crude oil or petroleum are known as organic because they are mainly made of carbon. The elemental composition of a typical petroleum is 82-87% carbon, 11-15% hydrogen, 0.1-6% sulphur, 0-2% oxygen and 0.01-3% nitrogen. Thus crude oil is primarily hydrocarbon, with minute amounts of such other compounds as furans, thiophenes, acids, mercaptans and some inorganic species. To say that crude oil or refined oil is toxic to plants and animals, including man, hardly scores any extra point.

Types of Oil Spillage

Oil spill is categorized into four groups namely:

- ❖ **Minor spill** occurs when the volume of the spilled oil is less than 25 barrels in inland water or less than 250 barrels on land; offshore or coastal water that does not pose a threat to public health or welfare.

- ❖ **Medium spill** takes place when the volume of the spill is 250 barrels or less in inland waters or 250 to 2500 barrels on offshore and coastal waters
- ❖ **Major spill** occur when the oil discharged to inland water is in excess of 250 barrels in offshore or coastal waters.
- ❖ **Catastrophic spill** refers to any uncontrolled well blowout, pipeline rupture or storage tank failure which poses an imminent threat to the public health or welfare (cf. Egbe and Thompson, 2010).

Cause of oil Spillage

In Nigeria, 50% of oil spills is due to corrosion of pipelines and tanker accidents, 28% is due to sabotage, and 21 % are due to oil production operations while 1 % of the oil spill is due to engineering drills, inability to effectively control wells, failure of machines and inadequate care in loading and unloading oil vessels. Oil bunkering is also a source of oil spill (cf. Egbe and Thompson, 2010).

Materials and Methods

This involved obtaining data from past and present studies, government and non- government bodies and existing literatures. The study relied on secondary data, data was obtained from The Nigerian National Petroleum Cooperation(NNPC), World Bank Reports(WBR), National Bureau of Statistics(NBS), United Nations Environmental Protection Programme(UNEPP), Amnesty International(AI), International Monetary Fund (IMF), published and unpublished materials, books, newspapers, conference and seminar papers, journals and the internet.

Data analysis

The data obtained was analysed using descriptive method to obtain logical deductions and sequential presentation of facts from the data obtained to give a clear picture of the problem.

EFFECTS OF OIL SPILLAGE ON FISH

In Ibeno, Akwalbom State for instance, where Mobil's operations have reportedly led to the loss of fish populations along the coast, fishing is available only to those who can afford large boat engines and trawlers to venture into the high seas (cf. Egbe and Thompson, 2010). The rest of the population must buy "ice fish" (frozen fish) from commercial fishermen, a practice totally unknown a few years back. Since market prices are constantly on the rise, many villagers have to go without fish. Only a small sector of the local population in Ibeno finds employment in Mobil's facilities, and thereby earns money to buy food. The same situation goes to Niger Delta. The effect of oil spillage on fish can be therefore, categorized into direct and indirect effects.

(a) Direct effects of oil spills on fishes

Oil spills can impact on fish directly through three primary pathways: (i)**Ingestion** - when fishes swallow oil particles directly or consume prey items that have been exposed to oil; (ii)**Absorption** - when fishes come into direct contact with oil; and (iii)**Inhalation** - when fishes breathe volatile organics released from oil or from "dispersants" applied by response teams in an effort to increase the rate of degradation of the oil in seawater.

(i) **Ingestion** of oil or dispersants can cause gastrointestinal irritation, ulcers, bleeding, diarrhoea, and digestive complications. These complications may impair the ability of

animals including fishes to digest and absorb foods, which ultimately leads to reduced health and fitness. Ingestion can occur at multiple levels of the food chain. Top predators like perch, Muskie (muskellunge), pike, walleye and salmon may become vulnerable to large quantities of pollutants through bioaccumulation (the increased concentration of toxins found at higher level of the food chain).

(ii) **Absorption** of oil or dispersants through the skin can damage the liver and kidneys, cause anaemia, suppress the immune system, induce reproductive failure, and in extreme cases cause death. The skin of some species may experience irritation, burns, and infections. Exposure of oil to fish eggs in the water or sea turtle eggs on beaches can lead to slower embryonic growth; lower hatching rates, and developmental impairments.

(iv) **Inhalation** of volatile chemicals (vaporized materials released by oil floating on the surface) commonly occurs among those species of fishes that need to breath at the surface of the water. Inhalation of these harmful materials can cause respiratory inflammation, irritation, emphysema, or pneumonia.

(b) **Indirect effects of oil spills on fishes**

Oil spills can also have indirect effects on wildlife by causing changes in behaviour: relocation of home ranges as animals search for new sources of food increases in the amount of time animals must spend foraging disruptions to natural life cycles.

(i) **Changes in foraging locations may result from oil spills.** If a spill causes direct mortality to the food resources of a particular fish species, many individuals of this species will need to relocate their foraging activities to regions unaffected by

the spill. This leads to increased competition for remaining food sources in more localized areas. This congregating can be especially problematic for rare species which may become more susceptible to predation or to future catastrophic events while a large proportion of the population forages in a few concentrated patches.

(ii) **Increases in foraging time may be required to meet energetic requirements.** Fishes 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 digested less efficiently. Decreases in diet diversity due to lower food availability may lead to reduced overall health. At the same time, the energetic requirements of these animals may be heightened, due to the physiological challenges brought on by exposure to the oil (difficulty maintain temperature balance or compromised immune systems).

(iii) **Disruptions to life cycles may become apparent if particular life forms are more susceptible to the effects of oil than others.** Eggs, larvae, and juveniles of many species are more vulnerable to harmful effects from pollutants than adults. Changes in the relative numbers of individuals from different life stages within a species may lead to shifts in habitat use patterns which cause ripple effects up and down the food chain. Furthermore, if all individuals of a life stage of a species are decimated, the ability of the species to rebound after the spill is greatly reduced.

SUSCEPTIBILITY OF FISH TO OIL SPILLS

The vulnerability of various species of fishes to an oil spill changes as time since the spill increases. Species that spend time at the surface of the water will be impacted most during the

early stages of the spill. Once the oil begins to wash ashore, species that utilize the shoreline are affected. Finally, influence on benthic species begins once the oil particles leave the surface and become mixed throughout the water column. Eggs and hatchlings are susceptible through absorption. If oil pollution occurred during nesting season say spring, which means that eggs and hatchlings are likely to experience high risk of exposure to oil spills that occur this time of year.

Fortunately, mature fish and other animals tend to swim away from the oil slick and therefore hardly ever cut up in the pollution problem. Fish eggs or roe that have already been spawn, as well as fingerlings or fry are the victims not only by toxic effect of the parse, but essentially by the fact that oil clings to the gills of fish and prevents oxygen extraction from water, by them. So, such fish die of oxygen starvation.

Table 1: The physical presence of the oil industry in Nigeria

1	Land area within which the networks of pipelines are located	31,000 km ²
2	Number of oil wells drilled	5,284
3	Number of flow-stations	257
4	Length of main oil and gas pipelines in the region (flow lines between oil wells and flow-stations not included)	7,000km
5	Number of export terminals	10
6	Number of communities hosting oil/gas facilities	1,500

Source: After Steiner (2008)

Susceptibility of fish to oil spills

The vulnerability of various species of fishes to an off-shore oil spill changes as time since the spill increases. Species that spend time at the surface of the water will be impacted most during the early stages of the spill. Once the oil begins to wash ashore, species that utilize the shoreline are affected. Finally, influence on benthic species begins once the oil particles leave the surface and become mixed throughout the water column. Eggs and hatchlings are susceptible through absorption. If oil pollution occurred during nesting season say spring, which means that eggs and hatchlings are likely to experience high risk of exposure to oil spills that occur this time of year.

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DISCUSSION

The magnitude of harm caused to wildlife by oil spills varies according to a number of factors: the amount of exposure of each animal to oil the pathway through which each animal is exposed to oil the age, reproductive state, and health of each animal the type of synthetic chemicals used by response teams to clean the spill

(a) **The magnitude of exposure:** The magnitude of exposure an animal has to oil influences the degree of harm caused (such as the amount of time the skin is in direct contact

with oil, or the amount of toxic material ingested or inhaled). The more extensive the area an oil spill covers, the more difficult it becomes for animals to avoid the oil particles, and the greater the magnitude of exposure.

(b) **The length of time of exposure:** The longer the time period over which oil is present at the surface, the greater the likelihood of exposure to species that forage at or near the surface. Wave action and prevailing winds can accelerate the rate of mixing of oil from the surface into the water column, reducing exposure to species that spend time at or near the surface, while increasing exposure of benthic organisms to smaller particles.

(c) **The route of exposure:** The route by which fish is exposed to oil (ingestion, absorption, or inhalation) can also influence the rate and toxicity of the effects. Fishes with varied diets may have fairly limited contact with oil through the ingestion route, whereas low-mobility animals that need to breathe at the surface will have high rates of exposure through inhalation due to their limited ability to escape the extent of the spill.

(d) **The age, reproductive state, and the state of health of fish at the time of exposure:** The age, reproductive state, and overall health of fish may influence the degree of harm caused by exposure to an oil spill. In general, eggs, larvae, and early juvenile life stages are more susceptible to oil and to chemical dispersants than adult animals of most species. Widespread mortality of larvae from the year a spill occurs will have long-term consequences for the species due to a reduction of the capacity of the species to rebound the following year when fewer reproducing individuals are present. Also, individuals of

lower fitness are likely to be impacted to the greatest extent by the additional stresses imposed by an oil spill.

(e) **Kind of synthetic materials exposed:** The types of synthetic materials used by response teams to clean up or disperse oil can influence the magnitude of harmful effects felt by wildlife. Materials called “dispersants” are surfactants that are often applied to an oil spill site to increase the rate of degradation of oil. The use of these dispersants can reduce exposure to harmful effects caused by the inhalation of toxic materials by animals visiting the surface to breathe, and can reduce impacts to shoreline habitats. However, these materials may increase the harmful effects of oil on the insulation abilities of bird feathers. Dispersants also cause oil particles to disperse deeper into the water column where the oil may cause more harmful effects to benthic animals in deeper waters.

From the literature review of the oil exploration and exploitation activities in Niger Delta of Nigeria, there is no doubt that oil development activities have contributed to the growth and development of the country in general. But the oil pollution caused by spillages from the oil industry located primarily in the Niger Delta region has caused the massive destruction to farmlands, sources of drinking water, mangrove forest, fishing grounds and declination of fish, crabs, molluscs, periwinkles and birds. Large areas of mangrove forest have been destroyed over a wide area affecting terrestrial and marine resources.

Some past spills have necessitated the complete relocation of some communities, loss of ancestral homes, pollution of fresh water, loss of forest and agricultural land, destruction of fishing grounds and reduction of fish population, which is the major

source of income for the Niger Delta people(cf. Tolulope, 2004; CAB, 2009).

CONCLUSION AND RECOMMENDATION

The Niger River is an important ecosystem that needs to be protected, for it is home to 36 families and nearly 250 species of fish, of which 20 are endemic, meaning they are found nowhere else on Earth (cf. FME, 2006). Oil pollution can be lowered as well; if spills were reduced then habitat and environmental impacts could be minimized. Oil contamination affects the fish population and affects the farmers that rely on fishing to support their family. Speed restoration and cleaning is required to quickly correct these impacts of oil spillage in Niger Delta while every effort should be made to stop further spillage of oil in this region especially by the recent pipe line destruction via bombing.

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