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A Critical Review of the Effects of Oil Spillage on Land in Nigeria

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Abstract
Crude oil production is the largest and most profitable business in the world. From its development phase to production phase, many disasters have occurred in oil industries. Oil spill is the most important type of environmental disaster which usually occurs. It has impact on humans as wells as on plants and wild life, including birds, fish and mammals. Drilling and production accidents and everyday human activities are the main causes of oil spills. The oil spills are hazardous to environment and also affect human health. The adverse effects have been seen on soil, ground water, plants and animals. Immediate actions are required to eradicate the spill problem. Oil spill at any point may result into explosion and fire hazards. Effective attempts have been made for the remediation of the soil and cleaning the water resources on onshore and offshore. In this paper, some of the known and new methods of remediation have been discussed to solve the oil spill problem. Remediation techniques for marine as well as onshore environment are available but still more advance researches are required. New techniques like soil vapor extraction, degradation, bioremediation are major methods of soil remediation. Physical, chemical bioremediation methods are used for cleaning oil spills in land environment.

Keywords: *Environmental effects*

1.1 Background to the Paper:

Oil spills are a significant environmental issue with severe impacts on ecosystems, communities, and public health. There are inherent risks associated with oil extraction, transportation, and storage, resulting in frequent oil spillage incidents around the globe. There has been severe environmental degradation caused by these spills, which has long-term ecological and socio-economic consequences (National Research Council, 2003).

Internationally, oil spills have been shown to cause significant damage to marine life, coastal ecosystems, and biodiversity. For example, the 2010 Deepwater Horizon oil spill in the Gulf of Mexico led to the release of millions of barrels of oil, resulting in extensive contamination of marine habitats and severe impacts on fish populations and other marine organisms (National Research Council, 2003).Similarly, the Exxon Valdez oil spill in Alaska in 1989 had long-lasting

effects on the region's wildlife and ecosystems, leading to declines in fish and bird populations and persistent contamination of coastal environments

In the continental context, oil spills have been shown to negatively impact marine life, coastal ecosystems, and biodiversity. Africa has a substantial presence in the global oil industry, with several countries heavily dependent on oil production for economic growth. There have also been numerous oil spillage incidents on the continent, particularly in regions with substantial oil reserves. As a result of these spills, ecosystems and communities have suffered devastating effects, which present significant challenges to sustainable development (Fingerman, 2012).

In Africa, Nigeria is one of the largest oil producers, with extensive oil exploration activities and a vast oil infrastructure (Egborge, Okoh and Daniel, 2018). The Niger Delta region, in particular, has been profoundly impacted by oil spillage due to its high concentration of oil reserves and associated facilities. The region is known for its rich biodiversity, including mangrove forests, rivers, and coastal areas, which serve as critical habitats for numerous species. As a result of oil spills in the Niger Delta, the delicate balance between the local ecology and the ecosystem has been irreversibly disrupted (Obi, Edeh, Okonkwo, and Ezenwaji, 2019).

Furthermore, oil spillage in Nigeria has a significant impact on terrestrial ecosystems, such as farmland and forests. As a result of contaminated soil, local communities that depend on farming face serious risks to agricultural productivity (Nduka, Orisakwe, and Ezenweke, 2017). Additionally, oil spill incidents release toxic chemicals and air pollutants, posing a health hazard for nearby communities. This includes an increased prevalence of respiratory diseases, skin disorders, and reproductive problems among the affected population (Adeyemi, Okoh, and Fasae, 2018).

In Nigeria, measures have been implemented to address oil spillage and its associated environmental impacts but the problem persists. The challenges that have led to the continued occurrence of oil spillage in Nigeria include: pipeline vandalism, inadequate maintenance, and limited enforcement of regulations. Furthermore, the restoration and rehabilitation of affected areas, particularly in the Niger Delta region, present significant challenges due to the complexity of the ecosystems and the socio-economic factors involved (Onyema, Chukwu, and Uwah,2018).

Understanding the environmental effects of oil spillage in Nigeria is crucial for developing effective strategies to mitigate and prevent future incidents. This paper therefore explores the effect of oil spillage in Nigeria through the review of related literature, case studies, and research findings, amongst others. The paper therefore contributes to the already existing body of knowledge on this critical issues of oil spillage by providing recommendations for policy changes, improved regulations, and corporate social responsibility initiatives specific to Nigeria.

1.2 Statement of the Problem:

In Nigeria, oil spills pose a significant challenge that threatens not only the country's ecosystems, communities, and public health, but also has broader implications at the world and continental levels. In spite of efforts to regulate the oil industry and prevent spillage incidents, Nigeria still experiences frequent and devastating oil spills. Nigeria needs $12billion to carry out an oil spill

cleanup. Consequently, these spills lead to severe contamination of terrestrial and aquatic ecosystems, resulting in habitat destruction, biodiversity loss, and long-term ecological disruptions (Nwilo and Badejo, 2016). It can also have some socioeconomic effects on affected communities and region such as loss of livelihood, displacement and migration, economic decline.

Besides Nigeria, other oil-producing countries face similar challenges in the event of oil spills. Globally, oil spills have been a recurring problem with detrimental environmental effects.

They have been documented in regions such as the Gulf of Mexico, Alaska, and the North Sea, highlighting the transnational nature of the problem (Fingerman, 2012). As a result of the environmental impacts of oil spills in these regions, it is imperative that comprehensive understanding and effective measures are taken to deal with these disasters. According to the national oceanic and atmospheric administration (NOAA), an average of 14,000 oil spills occurs in the worlds ocean each year, amounting to nearly 700million gallons (2.6 billion liters) of oil released into the marine environments (NOAA,2021). These spills have catastrophic effects on marine life, coastal habitats, and the livelihood of millions of people who depends on the seas for sustenance and income The environmental impact of oil spills in these regions underscores the need for comprehensive understanding and effective measures to address such incidents.

Several oil spillage incidents have occurred on the continent of Africa, particularly in countries with significant oil reserves and extensive oil exploration. As a result of these spills, ecosystems and communities have been negatively affected, posing significant challenges to sustainable development. The Niger Delta region in Nigeria is a prominent example of a heavily impacted area, where oil spillage has resulted in the contamination of water bodies, destruction of mangrove forests, and disruption of the delicate ecological balance (Obi et al., 2019). The Niger Delta, one of the world most important wetland regions, has been severely affected by oil pollution, with an estimated 546million gallons (2.06 billion liters) of oil spilled into its delicate ecosystem over the past five decades (Council of Foreign Relation, 2021). The Niger Delta's biodiversity-rich mangroves, swamps, and rivers have borne the brunt of this ecological disaster, causing irreversible damage to aquatic and terrestrial life and exacerbating poverty and social instability in the region.

In Nigeria specifically, the causes and frequency of oil spillage incidents contribute to the persistent and detrimental effects being recorded. Factors such as pipeline vandalism, equipment failure, operational negligence, and inadequate maintenance of oil infrastructure are key drivers of oil spills (Osuji et al., 2018). As a result of these factors, and challenges in enforcing regulations and implementing effective response strategies, the problem is exacerbated. The consequences of oil spillage extend beyond ecological disruption, significantly affecting terrestrial ecosystem likes like farmlands and forests, leading to contamination that jeopardizes the agricultural productivity and the livelihoods of community's dependent on farming (Nduka et al.,2017). This agricultural downturn contributes to the broader socioeconomic effects of oil spill by diminishing income sources and exacerbating poverty levels among affected populations. Additionally, the release of toxic chemicals and air pollutants during oil spill incidents threaten not only the environment but also the health of nearby communities, resulting in an increase in respiratory diseases, skin disorders, and reproductive problems (Adeyemi et al., 2018). These health issues place an

additional burden on local healthcare systems, causing economic strain and reduced productivity within these communities, further highlighting the intricate interplay between environmental and socioeconomic impact in the wake of oil spills.

The Niger Delta is home to diverse habitats, including mangroves, swamps, and rivers, which provide critical breeding grounds and habitats for various species of flora and fauna. These ecosystems not only sustain the region's biodiversity but also support the livelihoods of millions of people who rely on fishing, farming, and other natural resources for their sustenance. Unfortunately, oil spills disrupt this delicate balance, leading to the death of marine and terrestrial organisms and affecting the reproductive success of species in the area.

One of the key challenges in addressing oil spillage in Nigeria is the difficulty in identifying and holding responsible parties accountable for these incidents. In many cases, pipeline vandalism and oil theft contribute significantly to the occurrence of oil spills. Criminal elements engage in illegal bunkering activities, causing damage to oil infrastructure and leading to oil spills that go undetected until much damage has already been done.

Additionally, the lack of comprehensive and well-implemented environmental regulations has hindered efforts to prevent and effectively respond to oil spills. The existing laws often lack proper enforcement mechanisms and penalties for non-compliance, creating a lax attitude towards safety measures within the oil industry. As a result, oil companies may neglect essential maintenance and safety protocols, leading to avoidable oil spillage incidents.

In conclusion, the environmental effects of oil spillage in Nigeria present a significant challenge that demands urgent attention and effective solutions. The effects of oil spills on terrestrial and aquatic ecosystems, human health, and livelihoods underscores the need for comprehensive strategies to prevent and respond to oil spill incidents. The study of oil spillage in Nigeria is necessary to address the multifaceted impacts it has on the environment, human health, economy and social fabric of the country. The finding can lead to better policies, practices, and strategies aimed at preventing future spills and mitigating the damage caused by existing ones.

1.3 Aims and Objectives

The aim of this paper is to discuss the environmental and socio-economic effects of oil spillage. To achieve this aim, the following objectives were formulated and pursued:

1. to review the environmental effects of oil spillage in Nigeria,
2. to review the effects of oil spillage on Agriculture,
3. to review the socioeconomic effects of oil spills on communities living near oil producing region, and
4. to discuss sustainable solutions for mitigating the adverse effects of oil spillage in Nigeria.

2.0 Literature Review.

The review of related literature was conducted under the following headings:

- The environmental effects of oil spillage.
- Effects of oil spillage on Agriculture.
- The socio-economic effects of oil spills on communities living near oil producing region.
- The sustainable solutions to mitigate the adverse effects of oil spillage in Nigeria.

2.1 Environmental Effects of Oil Spillage

Osuagwu and Olaifa (2015), did a work on "Effects of oil spills on fish production in the Niger Delta". According to their work, The Niger Delta region consists of highly diverse ecosystems that are supportive of numerous species of terrestrial and aquatic fauna and flora. Crude oil spills endanger fish hatcheries in coastal water and also contaminate valuable fish. They examined the effects of oil spills on fish production in the Niger Delta of Nigeria from 1981–2015 using an estimable Cobb Douglas production function. Their findings suggested that oil production and spills negatively affect fish production, while farm labour has a positive effect on fish production. On the other hand, fishery loan exerts a negative effect on fish production and this could be ascribed to the bottlenecks in accessing these loans. Their study corroborated the findings in literature on the negative concomitance of oil spills and fish production and suggested a cautious approach to oil exploration activities for a sustainable development in the region.

Aghalino and Eyinla (2009) did a work on "Oil Exploitation and Marine Pollution: Evidence from the Niger Delta, Nigeria", they examined two cases of oil spillages and their concomitant impact on the flora and fauna of the Niger Delta region of Nigeria, where much of Nigeria's oil and gas is exploited. They evaluated how the oil firms and the federal government responded to the despoliation of the environment occasioned by the Texaco/Funiwa-5 oil blow out and the Qua Iboe oil spillage. They made use of both primary and secondary sources of information and data to analyze the issues in contention. The findings of the study showed that neither Texaco nor Mobil made genuine effort to combat the oil spilled from their various platforms until much harm had been done to the environment. This led to environmental pollution, which resulted in the drying up of vegetation and deprivation of plant and animal life. The author suggested the need for government to impose strict liability for environmental degradation. The Nigerian government should go beyond command and control approach to pollution abatement and adopt various economic instruments to combat oil industry-induced environmental pollution. The paper concluded that the oil producing companies in Nigeria should adhere to international best practices in oil exploitation.

Ojimba (2012) in his work," Determining the Effects of Crude Oil Pollution on Crop Production Using Stochastic Translog Production Function in River State Nigeria" examined the effects of oil pollution on crop production in Rivers State, Nigeria on a sample of 296 respondents drawn from 17 out of 23 Local Government Areas. He applied a stochastic trans-log production function in a multi-stage sampling technique. The results indicated that the effect of crude oil pollution on crop farms reduced the size of farmland, significantly at 1%, reducing marginal physical product (MPP), while in non-polluted farms output increased. Physical inputs, crude oil pollution variables and their interactions show strong negative (diminishing) returns to scale in oil polluted farms, but in non-polluted farmlands results indicate strong positive returns to scale. The technical efficiency results show that less than 22% of crop farmers were over 80% efficient in their use of resources

in oil polluted farmlands, while technical efficiency in non-polluted farmlands indicated a high efficiency of 33%. Given the present circumstances in the Niger Delta and the need for improved economic activities for the population, it became very imperative for studies to explore the impact of environmental degradation on specific issues such as fish production to enable policy makers pin-point areas of concentration in the implementation of various policies for the economic development of the region.

Kadafa, (2012) in his work "Environmental Impacts of Oil Exploration and Exploitation in the Niger Delta of Nigeria," examined the environmental impact of oil exploration and exploitation in Niger Delta of Nigeria using tabular analysis of data obtained from secondary sources. The study finds that the oil industry sited within this region has contributed enormously to the economic growth of the country but unsustainable oil exploration activities have rendered the Niger Delta region one of the five most severely damaged ecosystems in the World. Also, Adati (2012) assessed oil exploration and spillage in the Niger Delta region of the country, using comparative analysis of secondary data covering periods from 1976 to 2000 on descriptive techniques such as line and bar graphs, and found a decrease in oil spillage quantity but an increase in the number and times of oil spill.

Also, the problem of illegal bunkering and vandalizing petroleum pipelines contribute immensely to oil spillage and degradation of the environment.

Adamu, Yeboah, Sarfo, Nunoo, Kwang, Addai, Oduro, Darko,Ndafira, Batame, and Appea (2021) in their work "Assessment of Oil Spillage Impact on Vegetation in South-Western Niger Delta, Nigeria". They assessed the impact of oil spillage in the Southwestern Niger Delta of Nigeria over the past fifty (50) years. They sought to find out the driving forces and implications of oil spillage on vegetation, livelihoods and other key parameters. They employed geospatial techniques and a secondary source of data to achieve the set objectives. The Global Moran I statistical tool was used to determine the spatial autocorrelation based on feature locations and attribute values. They observed built-up areas, bare land, and less dense vegetation had an overall increment of 1975.98 km^2, 1370 $km^2$and 23805 km^2, respectively. Dense vegetation had declension of 22058.33 km^2 over the past five decades. Findings depict a declining trend in Normalized Difference Vegetation Index, attributed to oil spillage as the key contributory factor. Occasioned by anthropogenic activities, the driving forces were traced to attacks on oil pipelines during conflicts and illegal means of creating leakages to siphon crude oil for sale. To achieve sustainability in oil spill management in the Delta, the study recommends further research to ascertain the cost of losses incurred apply geospatial techniques to monitor and predict environmental changes that inform decisions of key actors.

Opafunso and Oniyide, (2010) carried out a research on, environmental effect of Oil Spillage in Bomu Community, Rivers State, Nigeria. They adopted method such as oral interview, physical observation and field sampling of soil and water. Heavy metals in the soil and water samples were determined using Atomic Adsorption Spectrometer (AAS). Their findings showed that environmental characteristic (social distortion, soil and water) has significant effect on the inhabitant of Bomu community and that has been severely distorted, the chemical analysis result of soil and water samples shows that they contained high level of heavy metals when compared

with Food and Agricultural Organization (FAO) and World Health Organization (WHO). The soil sample showed high level depletion of vital nutrients that are necessary for plant growth, for instance, Iron content is 4.68mg/kg and Phosphorus 4.48mg/kg. These values are below the FAO standard also water quality parameter such as pH is 5.1 and copper 0.3mg/l do not conform to WHO standards. The concentration of lead in water samples A, B, C, D and E are 0.17, 0.15, 0.24, 0.16 and 0.21 respectively. These concentrations are above the WHO standard of 0.10mg/l most especially in A and E were the impact of oil spillage is frequent, this might be responsible for the recurrent report of toxic biochemical effect in the water of the study area. It is recommended that best practices are adhered to in oil exploration, transportation and storage as this would minimize the occurrence of oil spillage in future. Meanwhile, the cleaning up of the area should be carried out as soon as possible and some compensation should be paid to the people who have suffered for a long time from the damaging spill. Since Ghana is planning to commence Oil exploitation, Ghanaian Government should borrow a leaf from the Nigerian experience.

Osuagwu, Joachim and Nwachukwu. (2014) in their research "Effects of Oil Spillage on Groundwater Quality in Nigeria", ascertained the effect of oil spillage on groundwater quality in the oil producing Niger Delta region of Nigeria. The research was carried out in Abacheke community in Egbema Local Government area, Imo state. Water Samples were collected for quality analysis in boreholes/wells at three locations A, B, C. Locations A and B are areas with history of spillage while C is a location downstream with no history of oil spillage. The following parameters were tested for; physical parameters (temperature and turbidity), inorganic constituents (Conductivity, PH, TDS, DO, BOD, Mg, and P) and organic constituents (Total hydrocarbon) The results showed some parameters exceeded the WHO permissible levels. Comparatively, Sample C had a lower value of hydrocarbon content (0.6 mg/l) while Samples A and B values were 0.9mg/l and 1.1mg/l respectively. The Turbidity value for sample C was 5 NTU compared to values of 14 and 18 NTU from samples A and B respectively. Results of PH test also showed that samples A and B were more acidic (5.56 and 5.98 respectively) than Sample C. The higher level of Turbidity and Total hydrocarbon for samples A and B is an indication of oil pollution which is attributable to incessant spillage. It is therefore necessary that appropriate treatment be carried out on the water samples to avoid adverse health effects. We also recommend that comprehensive groundwater monitoring should be carried out in the Niger Delta area and cleanup exercises carried out whenever there is an oil spill to prevent infiltration of oil into the ground water.

Amaechi, Onweremadu, Uzoho, and Chukwu, (2022) in their work "Physio-Chemical Properties of Wetland Soils Affected by Crude Oil Spillage in Niger Delta Area, Nigeria" emphasized on the loss of soil fertility through loss of soil organic matter, leaching of nutrients, loss of the nutrient-laden topsoil, changes in soil-pH, reduction in cation exchange capacity, salinization, water logging and other forms of soil degradation are major problems associated with agricultural productivity in the oil producing areas of Nigeria. This analysis investigated some selected physio-chemical properties of wetland soils affected by crude oil spillage in Bodo city in the Niger Delta region of Nigeria. Field reconnaissance survey using a handheld Geographic Positioning system (GPS) and survey technique involving random sampling, was used in siting soil profile pits. The unpolluted samples were collected 50 meters away from the polluted site but in the same geographic region and was used as control site. Soil samples were collected based on degree of

horizon differentiation and analyzed using routine and special analytical techniques. Soil data were subjected to analysis of variance using Genstat program. Result shows that soil physical properties of the polluted site: moisture content, soil bulk density, and soil texture were highly significant (p=0.01 and 0.05) when compared to the unpolluted site while some chemical soil properties analyzed especially soil pH, organic matter, carbon-nitrogen ratio, available phosphorus were affected by crude oil spillage. Results from this study affirm that crude oil can have detrimental effect on soil physio-chemical properties, which implies low soil fertility and thereby affect crop production and increase food insecurity within the study site. Further studies involving more edaphic properties, bio toxic metals and their bio accessibility in crops growing on waterside affected by crude oil spill will surely enhance knowledge and management of the these highly industrially influenced soils. Also, international and national oil and gas companies should carry out their activities with international best practice.

Duru, Ossai, and Arubi,(2013) in their work "The After Effect of Crude Oil Spillage on Some Associated Heavy Metals in the Soil", noted that Crude oil spillage is one major means of environmental pollution in oil and gas exploration and production. Heavy metals in crude oil are of varying concentration that can affect the concentration of the naturally occurring heavy metals in the soil after a spill. This situation brought about an artificial imbalance in the heavy metals concentration in the soil. Data were collected from two locations within a window of two and six months after the spillage and analyzed to determine the concentration levels of some associated heavy metals in the soil. Soil samples from the polluted and unpolluted areas were collected from the topsoil and subsoil and analyzed for these associated heavy metals. The results showed that there were increased concentrations of Zinc (Zn), Manganese (Mn), Lead (Pb) and Iron (Fe) two and six months after the crude oil spillage but Nickel (Ni) did not show any increased concentration. Copper (Cu) however, showed an increased concentration in the polluted area than the unpolluted area after two months of the spill but no increase in concentration after six months.

Njoku, Iwuji, Ikechukwu, and Okoro, (2021).investigated the effects of oil spillage on the surface water resources at Mmahu, in Ohaji/Egbema L.G.A., Imo State. They suspected that oil exploratory and/ exploitation activities have degraded surface water resources in the area. They determined the extent of damage to surface water by oil spillage. Water samples were collected from 4 locations distant from each other. The water samples were analyzed using spectrophotometers, and calibrated pH meters, weighing balances. The results showed that the oil spill introduced some heavy metals such as Lead, Manganese, Chromium and Arsenic into the water. It was also discovered that the concentration of the parameters tested, were affected by increase and decrease in distance close to and from the pollution source. The pH values went up from 4.88 in Station 'A' to 5.16 in Station 'C', indicating decrease in acidity from 'A' to 'C', while the control station was 6.5. Temperature of the water rose from 29oC in Station 'A' to 26oC in 'B' and 24oC in 'C'. Average of 171.9Mg/l of total hydrocarbon content was also evident in the water samples when compared with the control. These results reinforced the need for quick oil spill response in any area of occurrence.

According to Ipingbemi (2009), in his work "Socio-economic implications and environmental effects of oil spillage in some communities in the Niger delta" examined the effects of oil spillage on the socio-economic activities of the people and the environment in some communities in the Niger delta. The objectives was to determine the quantity of oil spilled from pipelines, the area of coverage and to assess the effects of oil spillage on the people, soil and water. Data were collected from both primary and secondary sources. Secondary data were sourced from published materials. Also, soil samples from four locations and water samples from five locations were collected to determine the pH value of the water, the presence and concentration of heavy metals in the soil and the total hydrocarbon content (THC) of water. Soil and water samples were analyzed using the atomic absorption spectrophotometer and gravimetric methods for soil and water, respectively. There was a strong relationship between the volume of oil spilled and the area coverage. Laboratory soil analysis from sampled communities showed a higher concentration of heavy metals (chromium, lead, arsenic, etc.) above the World Health Organization (WHO) permissible levels as well as the figure for controlled site. Similarly, three of the communities studied had THC concentrations of 40,000 ppm exceeding both WHO limit of 1 ppm and controlled site. Findings reveled that oil spill poses health treat to humans that consume fish from contaminated river. It is, therefore, important that environmental laws should be strictly adhered to. Compensation should be adequately and promptly paid to the communities, and remedial action should be speedily undertaken whenever there are spills. Finally, the oil companies must involve the communities in the maintenance and monitoring of pipelines with the ultimate goal of improving the quality of life of members of rural communities.

2.2 Effects of Oil Spill on Agriculture

Ahmadu and Egbodion (2012) carried out a study on the effects of oil spillage on cassava production in the Niger delta region of Nigeria using a simple random technique to select 17 cassava farmers each from three oil spillage communities (otor Udu, olomoro and Uzere) and three from non-oil spillage communities (Egini, Aradhe and Ellu) giving a total sample size of 102 respondent for the study. Their analysis was done through the use of descriptive statistics, likert scale, t-statistics and regression analysis. The results of their findings showed that the major significant effects of oil spills on cassava production perceived by the farmers included crop failure, poor yield, rotting tubers, and stunted crop growth with mean scores of 4.80, 4.78, 4.75 and 4.75 respectively. Others included increased soil temperature and toxicity (mean: 4.73), reduction of soil fertility (mean: 4.70), degradation of farm land (mean: 4.70) and low land productivity (mean: 4.70). The results further indicated that the cassava farm size, yield and land productivity in oil spill affected communities were significantly ($p < 0.01$) lower than those of the non-oil spill affected communities by 0.61 ha, 6119 metric tonnes (MT) and 1447 MT/ha respectively. These represent significant reduction of 36%, 48% and 20% of these variables in the oil spillage affected communities respectively. About 45% of the variation in land productivity in cassava production was influenced by oil spill and the farmers' farming experience. The productivity increased with increase in farming experiences, but decreased with increase in oil spills. The author therefore recommended constant maintenance of the oil pipelines and tankers to prevent corrosion and checking of the activities of saboteurs which often destroys oil pipelines.

Inoni et al. (2006) carried out a research on the Effect of Oil Spillage on Crop Yield and Farm Income in Delta State, Nigeria using a sample of 262 crop farmers drawn randomly from 10 communities and 5 Local Government Areas (LGAs) in the oil producing agro-ecological zones of Delta State. The result showed an accentuated negative impact of oil spills on crop production. Oil spills reduced crop yield, land productivity and greatly depressed farm income as 10% increase in oil spill reduced crop yield by 1.3%, while farm income plummeted by 5%. The authors recommended that there should be an enactment and enforcement of stringent environmental laws to protect the area as well as the implantation of polices to reduce the crushing level of poverty and guarantee a better livelihood for the people.

Ojimba(2012) carried out a study on determining the effects of crude oil pollution on crop production in Rivers State, Nigeria using a sample of 296 respondents drawn from 17 out of 23 Local Government Areas, and applied a stochastic trans-log production function in a multi-stage sampling technique as a method of study. The result of the study indicated that the effect of crude oil pollution on crop farms reduced the size of farmland (-2.5842), significantly at 1%, thereby reducing marginal physical product (MPP) with respect to land by 1.0186 and 1.9016 tons respectively, while in non-polluted farms output increased (0.3814 tons). Physical inputs, crude oil pollution variables and their interactions show strong negative (diminishing) returns to scale in oil polluted farms, but in non-polluted farmlands result indicate strong positive returns to scale. The technical efficiency results show that less than 22% of crop farmers were 81 to 100% efficient in their use of resources in oil polluted farmlands, while technical efficiency in non-polluted farmlands indicates a high efficiency of 33%. This result indicates that environmental degradation poses a serious threat to farmers by diminishing both physical ability and psychological desires to farm and the goal of farming may be defeated before the proper exercise, especially when the individual has no hope of any compensation when the crops are destroyed, or the waters are polluted, as always, the case in the Niger delta region. The author recommended a comprehensive scientific rehabilitation program for polluted farmland.

Thankgod et al (2012) studied the effects of crude oil pollution on horticultural crops in Rivers state, Nigeria. Multistage sampling procedure was used to obtain data from 17 local government areas. A total of 296 questionnaires were analyzed to obtain the results. The results showed that average hectare of horticultural farm cultivated was smaller in crude oil polluted farms (1.04ha) than in non- polluted farms (1.17ha). The results also revealed that output of horticultural crops in crude oil polluted farms (15.98tons) were lower than in non-polluted farms (18.75 tons), while farm income realized per farm was also lower in crude oil polluted farms ($324.70) than in non-polluted farms ($365.84). The values of output and farm income of fruits, banana, pepper, okra, leafy vegetables and melon were higher in non-polluted farms. The study concluded that crude oil pollution had detrimental and negative effects on horticultural crops output, farm income and area of farmland cropped. it is being recommended by the authors that crude oil pollution in the state in whatever form (acquisition of farmland for production, exploration and exploitation of crude oil spillages) should be minimized to acceptable minimum standard as it is practiced by the same multinational oil and gas companies in other parts of the world and this could be done by all stakeholders in the Nigerian oil and gas industry to enact and enforce laws for effective control rate of crude oil spillage and pipelines vandalisation on farmland. Akpokodje and Salau (2015)

carried out a study on oil pollution and agricultural production in the Niger Delta of Nigeria, the study employed an empirical analysis derived from a unique estimable production function based on Ramon Lopez's Cobb Douglas production function model. Findings established that increasing levels of oil spill and forest loss negatively affect agricultural productivity, while land, labour and capital positively improved agricultural productivity in the Niger Delta.

Asoya (2010) studied the impacts of oil spillage on agricultural production in Ibeno community. Personal interviews, observation, focused group discussion and questionnaires were the research methods employed in collecting data. The result from the finding showed that oil spillage has led to unproductive soil, thereby killing the peoples interest in agricultural activities particularly crop cultivation and fishing. The author recommended an establishment of permanent disaster management institution, community participation and involvement, and a review of laws by the government.

Chikaire et al (2015) studied the effects of oil spillage/ pollution on agricultural production by employing a simple random technique to select a sample of 115 respondents. The data used for the study were basically primary and secondary data. The primary data were collected from the field survey using questionnaires. The result from the study showed that oil spillage lead to reduction of soil fertility, increased soil temperature/ toxicity, low land productivity, poor yields and death of fishes, destruction of soil organisms, stunted growth of crops and failure, wilting of crops, toxicity of water available for livestock and outbreak of crop diseases, degradation of farmlands, destruction of soil structure, bad taste of produce and death of livestock, rotting of yams and cassava tubers and yellowing of crop leaves. The researchers recommended the establishment of disaster management institution, engagement of companies in preventive measures to mitigate the risk of oil spillage as well as transparency with regards to payment of compensations.

Wegwu et al (2011) studied the impact of crude oil spill in Obie Niger delta of Nigeria, after four years of recorded incidence. Field reconnaissance and physiochemical parameters (pH, total organic carbon and total organic matter) were used to assess the adverse effects of oil spill on the soil. Findings revealed lower number of flora (Elaiseguineesis and andropogongayanus), flora with stunted growth and chlorosis of leaves(zea mays and manihotesculenta) and lower number of fauna(Lumbricusterrestris). The pH value ranged between 6.47- 7.96, while the total organic carbon (TOC) and total organic matter (TOM) ranged between 1.25 – 3.27 and 2.15 – 5.26 respectively. The lower presence of flora and fauna, with acidic levels of pH and increased levels of total organic carbon and total organic matter of the crude oil spilled site show that the detrimental effects of crude oil pollution can linger for years.

2.3 The Socio-Economic Effects Of Oil Spills On Communities Living Near Oil Producing Region.

According to Umar, Khanan, Ogbonnaya, Shiru, Ahmad, Baba (2021) in their work "Environmental and socioeconomic impacts of pipeline transport interdiction in Niger Delta, Nigeria" stated that, pipelines have been the most economic medium for transporting crude oil to production and distribution facilities in the Niger Delta area of Nigeria. However, damages to the pipelines in this area by interdiction have hampered the continuous flow of crude oil to the

facilities. Consequently, the revenue of the government dwindles, and the environment is severely degraded. According to data from National oil spills detection and response agency, Nigeria is used to map spatial distribution of oil spills using Kernel Density Estimation with Geographic Information System. Literature was assessed to synthesize the historical, socioeconomic, and environmental impacts of oil spills and pipeline interdiction. Soil samples were collected from study area to determine the types of hydrocarbon pollutants and their concentrations in comparison with uncontaminated sites in the area. Results show that the range of concentrations of total petroleum hydrocarbon (TPH) for the impacted soil (IMP) was 17.27–58.36 mg/kg; remediated soil (RS) was 11.73–50.78 mg/kg which were higher than the concentrations of 0.68 mg/kg in the control samples (CS). Polycyclic aromatic hydrocarbons (PAH) concentrations were in the range of 0.43–77.54 mg/kg for IMP, 0.42–10.65 mg/kg for RS, against CS value of 0.49 mg/kg while BTEX ranged between 0.02 – 0.38 mg/kg for IMP, 0.01–2.7 for RS against CS value of 0.01. The values of the PAH were higher than the limits of the Department of Petroleum Resources, Nigeria. This study also revealed that pipeline interdiction has affected the livelihood of the inhabitants of the study area and the revenue of the Nigerian government. The major hotspots for oil spills in the Niger Delta region are Bayelsa, Rivers and Delta states.

According to Ipingbemi (2009), in his work "Socio-economic implications and environmental effects of oil spillage in some communities in the Niger delta" examined the effects of oil spillage on the socio-economic activities of the people and the environment in some communities in the Niger delta. The objectives was to determine the quantity of oil spilled from pipelines, the area of coverage and to assess the effects of oil spillage on the people, soil and water. Data were collected from both primary and secondary sources. The primary data relied on the administration of structured questionnaires; 319 questionnaires were randomly distributed to a sample population (household heads), with 302 retrieved. Secondary data were sourced from published materials. Findings revealed that many of the resident abandoned their education because they could not pay their school fees because their parent source of income (fishing) has been badly affected by oil spill. This has grave implications on the socio-economic activities of the people. It is, therefore, important that environmental laws should be strictly adhered to. Compensation should be adequately and promptly paid to the communities, and remedial action should be speedily undertaken whenever there are spills. Finally, the oil companies must involve the communities in the maintenance and monitoring of pipelines with the ultimate goal of improving the quality of life of members of rural communities.

According to Wizor and Elundonyi (2020) anchored his study on the socioeconomic impact of oil spillage in Gokana Local Government Area of Rivers State, Nigeria. Due to the landmass of the area, only three communities were selected and these were B-dere, K-dere and kpor communities. Purposive sampling technique was adopted to select these communities because of the incessant oil spillage in the area. Again, the sources of data used in this study include both the primary and the secondary sources while the instrument adopted to collect data from the sampled respondents was questionnaire. A total of 147 respondents were used as the sampling for the entire study which represents ten per cent (10%) of 1471 of farmers and fishermen who were the target population. In analyzing the data, the statistical tool used was percentages with the aid of a well-constructed table. The result of the survey showed that Farmers and fishermen are the most hit during an oil

spill, farmer's activities in the area have reduced to the barest minimum as a result of oil spillage and oil spills in the community have contributed to starvation in the area. The study further revealed that the high rate of polluted water observed is as a result of groundwater contamination in the area. Consequently, the study recommended among others; emphasis on remediation should not be an agitation for compensation rather a move to restore the originality of the land, the areas covered by SHELL pipes and their manifold should be declared a non-farm area and at the same time the company should make provisions for any zone classified as a farming center and the ongoing plans to implement the Ogoni UNEP Report should not be politicized.

Eyitayo and Augustine. (2020) in his work "Effect of Oil Spillage on Farm Income in Rivers State of Nigeria", investigated the effect of oil spillage on farm income in Rivers State of Nigeria using the Ordinary Least Squares (OLS) estimation technique and primary data obtained through the use of a well-structured questionnaire. This was with a view to assessing empirically the extent to which oil spillage has affected agricultural productivity in Rivers State of Nigeria. 225 farmland owners were included in the study and this sample was arrived at using multistage sampling technique. Of the 225 copies of the questionnaire administered, 206 copies were duly completed and returned by the respondents and this represented 91.6% of the total. The OLS results show that a negative and significant relationship exists between oil spillage and farm income in Rivers State of Nigeria. Farm size, labor hired and capital inputs employed were also included in the model to avoid model miss-specification, out of which only farm size and labor hired were found to have significant positive effects on farm income. The study therefore concludes that high incidence of oil spillage is inimical to agricultural productivity. Based on findings, there is need for comprehensive rehabilitation programs for polluted farmlands in Rivers State of Nigeria. Also, there should be a conscious effort by government and oil companies to develop the oil communities by setting aside a portion of the oil revenue for the purpose of developing these communities through the provision of basic infrastructure and amenities.

According to Edaba. (2023) examined the effects of crude oil spillage on the livelihoods of rural farm households in Bayelsa state of Nigeria. It identified and categorized the constraints limiting livelihood activities in rural farm households and estimated the determinants of farm income of oil-spilled households in the area. Primary data were collected through a multistage sampling technique to form a total sample size of 120 respondents. The study employed descriptive statistics such as means, percentage, pie-chart, frequency distribution; and inferential statistics such as multiple regression analysis and Chow's test. From the findings, many of the respondents had 11-20 years of farming experience. Again, 86% of the households combined farming with other livelihood options. Furthermore, the statistically significant determinant of farm income in the households were age, household size, farm size, years of farming experience and labor cost. The major constraints to livelihood activities in the area (in order of importance) were: inadequate land, poor input supply, financial constraints, high cost of labor, youth restiveness, and poor transport and communication facilities. There should be concerted action by various levels of government to develop policies geared towards making arable land readily available to farmers for agricultural purposes. Public policies on the management of oil pollution must evolve through collaborative arrangement between the government, oil producing companies and the community leaders of the oil producing areas.

Abah, Orisakwe, Okoromaand Emerhirhi (2020), in their work "Differential Effects of Oil Spillage on Cassava Farmers' Livelihood in Eleme and Ogoni Land Areas of River State, Nigeria", analyzed the effects of oil spillage on cassava farmers' livelihood in Eleme and Ogoni Land Areas of Rivers State, Nigeria. They examined the causes of oil spillage in the study area, examined the livelihood effects of oil spillage and factors influencing the effects of oil spillage on cassava production in the study area. Structured questionnaire was used to collect data from 400 cassava farmers selected through multi-stage sampling procedure. Percentage score, mean and Z-test were used to analyze the data collected. The result revealed that pipeline banalization was identified as the major cause (88.0%) of oil spillage in the study area. Non-payment of compensation to victims of oil spillage (M = 2.6), lack of access to credit/loan (M = 2.5), lack of access to improved varieties of cassava and weak implementation of environmental laws and policies (M = 2.4) were considered as factors promoting the effects of oil spillage on the livelihood of farmers. The result further showed that the mean effect of polluted farm respondents 2.3968; SD = 0.89, while the mean effect of non-polluted farm respondents on cassava production is 2.5510; SD = 0.5822with a mean difference of 0.1542, and thus implies the existence of a significant difference. The study concludes that oil spillage had a devastating livelihood effects on cassava farmers in the study area and therefore recommend effective implementation of mitigation measures to oil spillage in the area.

Iheke, Achu, and Nwaneri, (2019) examined the effect of oil spillage on the productivity of farmers in River state, Nigeria. A multi-stage random sampling procedure was used in selecting 111 respondents used for the study. Primary data collected were analyzed using descriptive statistics (frequencies, percentages, means) and econometric models like regression analysis, z-test and Chow's test. The results of data analyses showed that the level of agricultural productivity among the two groups of farmers in the study area was low. The mean level of agricultural productivity of the farmers in the oil spilt area of the state and farmers in the non-oil spilt area of the state were 3.65 and 5.37 respectively. Only about 21.05% of farmers in the Oil spilt area of the State and 25.93% of farmers in the non-oil spilt area of the state had a productivity index of above 60%. Farmers in non-oil spilt area of the state significantly have a higher level of agricultural productivity than their counterpart. Age of the respondents, educational status, and extension contact, and cooperative membership, access to credit, labor and capital significantly influenced agricultural productivity of farmers in the oil spilt area of River State. Age of the respondents, educational status, and cooperative membership, access to credit, labor and capital significantly determined the agricultural productivity of farmers on non-oil spilt areas of River State. Farming experience, cooperative membership, access to credit, labor, other farm inputs and capital significantly determined agricultural productivity of farmers on both oil spilled, and non-oil spilt areas of River state. Oil spillage negatively and significantly influenced the agricultural productivity of the farmers in the study area. The average cost incurred by the farmers in undertaking farmland remediation for improved agricultural productivity in the study area was N156, 052.63. It was recommended that land remediation measures should be included in land policies to improve farmer's productivity in oil spillage areas.

Isimah, (2020) in his work "The Socio-Economic Impact of Oil Spillage on the Production of Some Food Crops In Isoko South Local Government Area Of Delta State Nigeria", posited that

the significance of oil production on the growth and development of Nigeria is not in doubt since its discovery in commercial quantity in the Niger Delta Region in 1956. However, the damage posed by oil exploration on farming especially in the production of food crops in Niger Delta is a matter of intellectual discourse. A sample size of three hundred and ninety-nine (399) farmers and some staff of oil companies operating in the study area were randomly selected and used for the study. Both questionnaire and interview were employed for data collection and were analyzed with Spearman's Rank Correlation Coefficient Technique and One Way Chi-square Test. The findings revealed that equipment failure, pipeline corrosion, sabotage, oil well blow out, lack of maintenance of facilities and onshore discharge were the factors responsible for oil spillage. The findings also show that the regular occurrence of oil spills has led to decline in food crops production in the study area. It also indicated that oil spillage results to loss of farmers' income and shortage of foods in the study area. The study therefore recommended that government should compel the oil companies to control oil spillage using the existing policies on oil spills. Also, the oil companies should train their staff and provide adequate equipment to control oil spillage. Moreover, the oil companies should partner with the government to establish Oil Spill Compensation Agency (OSCA) to ensure prompt and adequate compensation on the affected farmers.

Alaba and Ifelola (2015) evaluated the economic effect of oil spillage on the local residents of Ilaje community in Ondo State. This was achieved by administering a well-structured questionnaire to the selected farmers, fishermen and traders who have experienced oil spillage in their environment in recent time. The data collected were tabulated in frequency table and analyzed by using Multiple Linear Regression. Two hypotheses were tested by using analysis of variance (ANOVA) statistical test. The result obtained from Multiple Linear Regression analysis shows that oil spillage has a significant effect on the income of the people of Ilaje community as confirmed by the negative values obtained in socioeconomic and environmental characteristics of the people. It was deduced that most of the income of the people was spent on the daily needs of the large jobless family size and treatment of various diseases caused by oil spillage in the area. The incomes of the people were also drained by a rapid reduction in aquatic animals and farm products over the years due to oil spillage. The result of the ANOVA test shows that differences in income of the farmers in the area represent the monetary values of their agricultural output destroyed during the oil spillage.

Odalonu (2015) in her work "The Upsurge of Oil Theft and Illegal Bunkering in the Niger Delta Region of Nigeria: Is There a Way Out?", observed that oftentimes illegal bunkering and petroleum pipeline vandalization results from destructive tendencies of restive youths, who are aggrieved by government neglect of oil producing communities and corruption of the ruling class in amassing wealth through collaborations with oil companies. Unfortunately, these social vices perpetrated by the youths have a counter-effect in increasing the levels of oil spill in the environment and the negative effect on water and land agricultural produce.

2.4 THE SUSTAINABLE SOLUTIONS TO MITIGATE THE ADVERSE EFFECTS OF OIL SPILLAGE IN NIGERIA.

Nuhu, Rene and Ishaq (2021) in their empirical study on "Remediation of crude oil spill sites in Nigeria: Problems, technologies, and future prospects", posited that crude oil is the major source of income to the Nigerian economy, which accounts for about 70% of government revenue and more than 83% of the country's total export earnings. Crude oil spills are frequent events in Nigeria and in the past 50 years, it is estimated that 10–13 million tons of oil have been spilled into the environment and more than 77% of it have not been recovered. The spills are caused by sabotage, oil exploration activities, equipment failure, pipeline corrosion, and tanker accidents. In most cases, simple and cheap remediation methods are employed which do not adequately consider the complexity of the different polluted media. The study reviewed the different remediation technologies for polluted water, soil, and sediment media that are appropriate for the local Nigerian environmental conditions. Bio stimulation was identified to have a high potential for cleaning polluted sediments in the Niger Delta, while ex- situ trenching and treatment are recommended for groundwater treatment and bioremediation is recommended for contaminated soils.

According to Adeniran, Oladunjoye, Doro (2023) in their work "Soil and groundwater contamination by crude oil spillage: A review and implications for remediation projects in Nigeria" stated that Management of soil and groundwater resources has been recognized as essential to meeting the sustainable development goals of Agenda 2063 of the African Union. As Africa's fastest growing population with over 200 million people, Nigeria is responsible for leading the continent's environmental sustainability goal. Nigeria has seen a sizable number of crude oil spillages that have contaminated its soils and groundwater resources, and several of these contaminated sites are to be cleaned up yet. There is need for more scientific data to design an effective cleanup and to manage the soil and groundwater resources effectively. So far, the only extensive crude oil-contaminated site remediation project documented is on Ogoni land in the Niger Delta region of Nigeria. However, this project resulted in less effective, albeit temporary, cleanup solutions. This review presented a state-of-the-art synthesis of research on soil and groundwater contamination by crude oil. It includes sections on processes, measurements, predictions, and management, as well as an analysis of the state and challenges in Nigeria. In-depth field, laboratory, and computer models for crude oil contamination investigation have been developed with over 60 years of significant research. However, studies and case projects in Nigeria have relied on point sampling to determine the concentration of crude oil contaminants in soil and groundwater. This method offers limited information on the solute concentration and hydraulic distribution, which regulates pollutant mobility within the subsurface. The absence of baseline and high-resolution subsurface characterization data has also resulted in a need for more process-based knowledge to direct the development of site-specific remediation strategies. As a result, it is challenging to design a conceptual model that is detailed enough to help with predictions of the flow dynamics of crude oil contaminants in the unsaturated and saturated zones.

Onwurah, Ogugua, Onyike, Ochonogor, and Otitoju (2007) in their work "Crude Oil Spills in the Environment, Effects and Some Innovative Clean-up Biotechnologies" examined that Crude oil, refined petroleum products, as well as polycyclic aromatic hydrocarbons are ubiquitous in various

environmental compartments. They can bio accumulate in food chains where they disrupt biochemical or physiological activities of many organisms, thus causing carcinogenesis of some organs, mutagenesis in the genetic material, impairment in reproductive capacity and or causing hemorrhage in exposed population. The cause effect of oil pollutant is usually quantified by using biological end point parameters referred to as biomarkers. Contamination of soil arising from spills is one of the most limiting factors to soil fertility and hence crop productivity. These deleterious effects make it mandatory to have a counter measure for the petroleum hydrocarbon pollutant in the environment. Bioremediation of petroleum hydrocarbon-contaminated environment is a potentially important application of Environmental Biotechnology. In this approach microorganisms are utilized under some specified conditions to ameliorate the negative effects in a cost-effective and environmentally friendly approach. The main strategies in bioremediation of oil spills, which include bio-stimulation, nutrient application, bio-augmentation, seeding with competent or adapted hydrocarbon-clastic bacteria or their consortium, and genetically engineered microbes, are reviewed. Although the promise of bioremediation is yet to be realized, innovative areas in Environmental Biotechnology for oil spill cleanup are highlighted.

2.5 SUMMARY OF FINDINGS

The finding from the literature review were reviewed as follows:

A. Environmental Effects:

1. Oil spill affect fish production negatively (Osuagwu and Olaifa, 2015).

2. Environmental pollution such as drying up of vegetation and deprivation of plant and animal life can occur due to oil spillage (Aghalino and Eyinla, 2009)

3. Reduces the size and quality of a farmland (Ojimba, 2012)

4.Oil spill causes a declining trend in normalized difference vegetation index (Adamu et al., 2021).

5. There is a high level of depletion of vital nutrient in the soil, necessary for plant growth (Opafunso and Oniyide, 2010).

6. Incestent oil spillage pollutes groundwater (Osuagwu et al., 2014)

7. Crude oil affect crop production by reducing soil fertility and increase food insecurity (Amaechi et al., 2022)

8. Increase in heavy metal caused by oil exploration degrade the soil (Duru et al., 2013)

9. Oil spill degrade surface water resources (Njoku et al., 2021).

10. oil spill poses harm to human health when oil spill contaminated food is ingested (Ipingbemi, 2009)

B. Effects On Agriculture

From the works of Ahmadu and Egbodion (2012), Ojimba(2012) and Thankgod et al (2012) amongst others reviewed, it was found that oil spillage has the following effects on Agriculture:

1. Reduces crop yield

2. Reduces varieties in crop production.

3. Affects land availability for farming activities.

4. Depreciates soil fertility.

5. Causes stunted growth in plants and reduce crop quality.

C. Socio-Economic Effect

1. Interdiction of pipeline affects the livelihood of inhabitant (Umar et al., 2021).

2.Resident cannot afford quality education due to the destruction of their source of income(fishing).

3. Farming and fishing activities have reduced to the barest minimum due to crude oil spill (Wizor and Elundonyi, 2020)

4. High incidence of oil spill is inimical to agricultural productivity (Eyitayo and Augustine,2020; Iheke, 2019)

5. Oil spill causes a major constraint on livelihood activities (Edaba, 2023)

6. Pipeline vandalization is a major cause of the devastating livelihood effects of farmers. (Abah et al., 2020)

7. Income of people are spent on large jobless families and treatment of various diseases caused by oil spillage (Alaba and ifeaola, 2015).

8. Decline in food crop production is caused by regular occurrance of oil spillage. (Isimah, 2020)

D. Sustainable Solution

1. Bio stimulation, ex-situ trenching and bioremediation can be used for groundwater treatment, cleaning polluted sediments and contaminated soils respectively.

2. point sampling is used to determine the concentration of crude oil contaminants in soil and groundwater. (Adeniran et al., 2023)

3. Bioremediation is a method used to degrade oil produce (Onwurah et el, 2007)

2.6 GAP IN LITERATURE

From the relevant literature reviewed, the following gaps were identified which accounts for the need for further research on the effects of oil spillage in Nigeria. These gaps are:

1. Although there were many studies which covered the environmental effects of oil spill on the soil and in groundwater, there are few works that concentrated on its effect in waterbodies.
2. Most of the studies were undertaken and done mostly in the Niger-delta part of the country. Little has been done in the south-south part of the country.

3.0 DISCUSSION OF FINDINGS

Oil spillage refers to the accidental or deliberate release of liquid petroleum hydrocarbons, such as crude oil or refined petroleum products, into the environment. These spill can have devastating effect on the environment and also socioeconomic effects in a country.

3.1 EFFECTS OF OIL SPILL ON THE ENVIRONMENT

Oil spillage is a severe threat to marine life, causing immediate and long-term harm to various aquatic organisms. According to Osuagwu and Olaifa, 2015, Oil spill affect fish production negatively. Fingas, 2014 stated, Oil spills lead to immediate suffocation and smothering of marine organisms. When oil coats the water's surface, it creates a physical barrier, obstructing the exchange of oxygen. This results in fish and invertebrates suffocating due to the lack of oxygen . The toxic components of oil, such as volatile organic compounds and polycyclic aromatic hydrocarbons (PAHs), can be inhaled by marine organisms, causing damage to their respiratory systems. This damage impairs their ability to extract oxygen from the water, leading to breathing difficulties (NOAA, 2018). Oil spills can disrupt the reproductive systems of marine life. Exposure to oil and its toxins can lead to reproductive impairments in various species, affecting their ability to reproduce successfully. This can have long-term consequences on population dynamics (NOAA, 2018). Oil spills lead to long-lasting ecological disruption. Marine ecosystems suffer habitat destruction, loss of biodiversity, and disturbances in food chains. Some ecosystems may take decades to recover fully, with some changes being irreversible (Peterson, Rice, Short, Esler, Bodkin, Ballachey and Iron 2003). The toxins from spilled oil enter the food web. Small marine organisms absorb these toxins, and as larger predators consume them, the contaminants accumulate and magnify in concentration. This poses risks to higher trophic levels, including marine mammals and birds (Anderson, Taylor and Dietze 2018). Also oil pollution alters the chemical composition of the water, affecting its pH, salinity, and dissolved oxygen levels. These changes can further stress aquatic organisms and disrupt the delicate balance of aquatic ecosystems (NOAA, 2018). This can result in shifts in the biodiversity of affected areas. Sensitive species may be lost, and oil-tolerant or invasive species might thrive. This can have long-term consequences for the structure and functioning of aquatic ecosystems (Peterson et al., 2003).

Also, from our findings, Opafunso and Oniyide, 2010 stated, there is a high level of depletion of vital nutrient in the soil, necessary for plant growth. Oil contamination can alter the physical and chemical properties of soil. It can lead to reduced soil fertility and hinder the growth of plants in the affected area. The presence of oil can affect the soil's texture and structure, making it less suitable for vegetation (Michel, 2015). Oil spills can harm soil microorganisms that play a crucial role in nutrient cycling. Microbial populations can decline in response to oil contamination, affecting the breakdown of organic matter and nutrient availability (Atlas and Hazen, 2011). Oil

contamination in soil can persist for years, making it challenging for ecosystems to recover. The residual oil can continue to have adverse effects on soil quality, plant growth, and the overall health of the terrestrial environment (NRC, 2003). This affect crop production by reducing soil fertility and increase food insecurity (Amaechi et al., 2022)

According to Adamu et al., 2021, Oil spill causes a declining trend in normalized difference vegetation index. Oil spills physically coat and smother vegetation. This results in the suffocation of plants and algae, reducing their ability to photosynthesize and obtain nutrients. As a consequence, affected vegetation may wither and die. The toxic components of oil, such as polycyclic aromatic hydrocarbons (PAHs), can be absorbed by vegetation. These compounds can harm plant cells and disrupt normal metabolic processes. This leads to immediate damage and the weakening of affected plants (Michel, 2015). This reduces the size and quality of a farmland (Ojimba, 2012).

Also, Oil can physically coat the feathers, fur, or scales of wildlife, leading to immediate damage. This can reduce the insulation and buoyancy of birds and marine mammals, making them vulnerable to temperature changes and impairing their swimming abilities (NOAA, 2018). Wildlife may ingest oil while attempting to clean themselves or while feeding in contaminated areas. Ingested oil can be toxic, causing internal damage, organ failure, and other health issues (Galarza et al., 2014). Birds and marine mammals can experience respiratory problems when exposed to volatile organic compounds and other toxic fumes released by the oil. This can hinder their ability to breathe and can lead to illness (Goldstein, Osofsky, and Lichtveld 2014). Incessant oil spillage pollutes groundwater (Osuagwu et al., 2014). Soil contamination from oil spills can pose health risks to humans, especially when oil-related toxins leach into groundwater or affect crops that are consumed. Monitoring and addressing these risks are crucial (ATSDR, 1999).

3.2 SOCIOECONOMIC EFFECT OF OIL SPILL

According to our findings, oil spill causes a major constraints on livelihood activities (Edaba, 2023). Fishing communities, often located near water bodies affected by oil spills, suffer immense losses as fish stocks are contaminated and reduced in number (Osuji et al., 2020).The decline in fish catches leads to decreased income for fishermen and women, threatening their economic stability and ability to support their families (Adelegan and Agbonlahor, 2018). Also, spills infiltrate agricultural lands, rendering soils infertile and affecting crop yields (Eze et al., 2019). Farmers are unable to cultivate their lands, leading to diminished food production. Subsistence farmers lose their primary source of food and income due to the inability to grow crops, pushing them further into economic hardship (Agbogidi, Emaziye and Ofuoku, 2017). Oil spills and related activities can force communities to relocate, often severing ties to ancestral lands and traditional livelihoods (Osuji et al., 2020). The loss of familiar landscapes disrupts established ways of life. Displacement can erode cultural practices deeply rooted in the land, leading to the loss of cultural identity and connection to heritage (Omofonmwan and Osemwegie, 2018). Areas affected by oil spills often lose their appeal as tourist destinations due to environmental degradation (Ibe and Ezekwesiri, 2018). The decline in tourism diminishes income opportunities for local communities. Restaurants, hotels, and other businesses that depend on tourism face reduced clientele and economic instability due to the decline in visitors. Livelihood destruction creates resource scarcity,

intensifying competition among communities for available resources like arable land or clean water (Etikerentse, Ekiyor and Umezulike, 2021). Loss of livelihoods can trigger rural-to-urban migration as individuals seek alternative opportunities, potentially straining urban infrastructure.

Oil spillage contributes to resource scarcity, such as clean water, fertile land, and fish stocks, leading to heightened competition among community members (Etikerentse et al., 2021).The struggle to access limited resources can trigger conflicts, sometimes escalating into violent confrontations over the distribution of essential goods.

Oil spillage may force communities to relocate, disrupting established social networks and traditional land use patterns (Osuji et al., 2020). Displacement can lead to disputes over land ownership between host communities and those forced to relocate, intensifying social tensions. Oil spillage can lead to clashes between fishing and farming communities, as the contamination affects their respective livelihoods (Akpan-Idiok, Okon, Aniah,2020). Differences in cultural practices and ethnic backgrounds can exacerbate conflicts arising from oil spillage's socio-economic impacts (AbdulrahimZakari and Yakubu, 2019). Oil spillage can lead to clashes between fishing and farming communities, as the contamination affects their respective livelihoods (Akpan-Idiok et al., 2020). Differences in cultural practices and ethnic backgrounds can exacerbate conflicts arising from oil spillage's socio-economic impacts (Abdulrahim et al., 2019). Environmental degradation and the economic impact of oil spillage can erode trust within communities, leading to strained social relations (Ekanem and Ajaero, 2017). Accusations and blame regarding the causes of spills can strain relationships among community members and with external actors. Also, the process of obtaining compensation for damages can spark conflicts between affected communities, oil companies, and government agencies (Ajayi, Fokayode and Agboola, 2020). Unequal distribution of compensation can lead to feelings of injustice and resentment among community members.

3.3 SUSTAINABLE SOLUTION

Bioremediation is a process that utilizes microorganisms like bacteria and fungi to metabolize and transform hydrocarbon contaminants found in oil spills into harmless byproducts (Atlas, 1995). In natural settings, microorganisms play a crucial role in breaking down hydrocarbons. Bioremediation essentially enhances and accelerates this natural degradation process (Prince, 2010). Bioremediation encompasses three distinct methods: bioaugmentation, biostimulation, and bioventilation. Bioaugmentation involves the introduction of specific oil-degrading microorganisms to the contaminated site (Atlas, 2004). This method enhances the existing microbial population's oil degradation capabilities. Biostimulation involves optimizing environmental conditions to promote microbial activity (Vidali, 2001). Adding nutrients or other growth-enhancing substances can significantly speed up the biodegradation process. Bioventing is another technique that injects oxygen into the contaminated site to stimulate microbial metabolism. This oxygen facilitates the breakdown of oil compounds (Rahman, 2002).

Bioremediation has been employed successfully in various oil spill cleanup efforts. For instance, it was used in the Exxon Valdez oil spill cleanup in Alaska and the Deepwater Horizon oil spill in the Gulf of Mexico (Venosa, King and Sorial, 2010). Bioremediation is known for its

environmental benefits, as it does not involve the use of harsh chemicals or mechanical removal methods that can further harm the ecosystem (Prince, 2010). Bioremediation is often a cost-effective approach compared to other cleanup methods, making it a practical choice for oil spill mitigation (Venosa et al., 2010).

Another method for oil spill mitigation is phytoremediation. It involves the use of living green plants or their roots to fix or absorb contaminants from soil. This approach uses enzymes present in plant roots to aid degradation of contaminants. It reduces contaminant concentration in soil and consequently reduces risk posed by such contaminants to the environment and human health. For example, Peng, Zhou, Cai, and Zhang (2009) used Mirabilis jalapa L. to remove 63.2% of petroleum from contaminated soil. Phytoremediation has five approaches which include phyto-stabilisation, phyto-volatilisation, phyto-extraction, phytodegradation and rhizodegradation (Wang et al., 2011; Lim et al., 2016). Phyto-stabilisation is the use of plant roots to absorb and precipitate contaminants thereby fixing them to a point and reducing their bioavailability and migration to other ecological systems such as food chain and underground water (Yao, Li, Xie and Yu, 2012). Phytovolatilisation is the transfer of contaminants (e.g. mercury) to a gaseous state by the use of special matters secreted by plant roots (Watanabe, 1997). Phyto-extraction on the other hand involves the use of tolerant and accumulating plants to absorb contaminants from soil, which are transferred and stored in over-ground parts (Yao et al., 2012). The breakdown of contaminants through the metabolic processes of the plant is described as phytodegradation. Plant roots in such cases release catalytic enzymes such as dehalogenase and laccase, to accelerate the contaminant breakdown process (Lim, Lau, Von and Poh, 2016). Rhizodegradation entails the degradation of contaminants through enhanced microbial activity in the rhizosphere zone (1–5 mm) of the soil. In this case, soil microbes benefit the soil by supplying the needed nutrients such as vitamins and amino acids to increase plant growth, while the plant roots provide habitat for microbes that degrade hydrocarbons (Germida,Frick, Farrell, 2002; Lim et al., 2016). Generally, the different approaches of phytoremediation have peculiar characteristics that make them appropriate for different soil contaminants. For example, phytovolatilisation is only appropriate for compounds with volatilisable properties. Phytoremediation provides an approach that allows for low maintenance cost, easily implemented on-site and in areas that generally support plant growth. Despite the benefits of phytoremediation in contaminated land clean-up, there still remain a gamut of challenges which have led to continuous search for more sustainable approaches (Susarla, Medina, and McCutcheon, 2002; Sas-Nowosielska, Kucharski, Malkowski, Pogrzeba, Kuperberg and Krynski, 2004). For example, specific phytoremediation prescription could not be applicable to diverse site conditions, as concentration levels could be toxic to the intervention plants (Susarla et al., 2002). Phytoremediation is a slow remediation strategy and could only be considered for long-term clean-up. In addition, the approach is affected by external parameters which include type and concentration of contaminants, water content, soil chemical properties and plant resistance to phototoxic effects (Lim et al., 2016), and prevailing ecological and climatic conditions. The primary challenge is to identify and select plant species which could withstand the toxicity of the contaminants (Peng et al., 2009; Lim et al., 2016). This is followed by the bioaccumulation of hydrocarbon in plants. Plants are affected by stress and pressure from other site conditions including the presence of pests, pathogens and insects. Plant exposure to these organisms and contaminants reduces the ability of plants over time to absorb contaminants. More

importantly, plant tissues (e.g. roots) responsible for contaminant uptake must be able to access contaminants in soil; thus, where contaminants have percolated into soil layers out of reach of plant root system the approach might be unviable. Also, safe disposal of used plants is a challenge yet to be resolved in many regions (Sas-Nowosielska et al., 2004).

4.1 SUMMARY

Oil spills are environmental disaster with far-reaching consequences. They pollute aquatic and terrestrial ecosystem, resulting in adverse effects on marine life, disruption of food chain, and suffocation of coral reefs. The socioeconomic effects are profound, encompassing harm to fishing and tourism industries, devaluation of property, and concerns regarding public health. However, mitigative measures exist. Prompt response and containment efforts, wildlife rehabilitation and dedicated research effort serve to curtail ecological harm. Prevention through improved safety measures, stricter regulations and advancements in spill response technologies is crucial.

Understanding and addressing both environmental and socioeconomic impacts are essential for effective oil spill management and long term recovery.

4.2 CONCLUSION

From the discussion so far, it is crystal clear that oil spill has oil spills has environmental and socio-economic effects, infact, if not properly managed can result in a lasting ecological and economical scar. As global demand for energy grow, it is our responsibility to prioritize responsible practices and sustainable alternatives, reducing our reliance on fossil fuels. Vigilance in safety, preparedness and public awareness remains our best defense against ecological and economic havoc that oil spill can wreck.

4.3 RECOMMENDATION

The following specific recommendation are based on the findings in this study

1. Regulation governing oil industries should be strengthened and enforced. This include rigorous safety standard, regular inspections, and penalties for noncompliance
2. Communities in vulnerable areas should be made aware and educated about the risk of oil spills and the importance of preventon and preparedness. It empowers the communities to becom active participants in safeguarding their environments and coastal areas.
3. Programs should be established to compensate affected individuals, businesses, and their communities for their losses and allocate resources for habitat restoration.
4. Alternative energy sources, such as renewable energy and sustainable technologies should be adopted. They lessen our reliance on fossil fuel and also contribute to a cleaner, safer and more resilient energy future and ultimately reducing the risks associated with oil spillage.
5. Research works on the environmental effects of oil spill should be carried out is the south-south part of Niger-delta

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