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Biodiversity Loss and Habitat Destruction in the Niger Delta: Evaluating the Efficacy of Mitigation Strategies and Environmental Policy

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Abstract
Objectives: This study explores the harmful impacts of oil exploration on aquatic biodiversity in the Niger Delta. It aims to examine the drivers of environmental degradation and the resulting consequences for both the ecosystem and the local population.

Method: The study synthesises existing literature and data on frequent oil spills resulting from pipeline leaks, equipment failures, and sabotage. It evaluates the efficacy of current mitigation efforts, such as bioremediation, and analyses the existing policy framework governing the region.

Result: The study finds that aquatic life is affected by habitat loss, pollution, and reproductive failure, resulting in significant declines in fish populations. These ecological damages have triggered severe socio-economic consequences, including loss of livelihood, food insecurity, and increased health risks for residents. Furthermore, the results indicate that, although

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environmental policies exist, their impact is limited by weak enforcement and persistent disruption of ecosystem balance.

Conclusion: Recovery in the Niger Delta remains limited despite current mitigation strategies. The study underscores the urgent need for stronger regulatory enforcement, improved spill-response mechanisms, and active community participation to protect aquatic ecosystems and secure the region's environmental and economic future.

Keywords: Aquatic biodiversity, habitat destruction, oil spill management, environmental policy, Niger Delta

Introduction

Oil spills are one of the most significant and pervasive environmental hazards associated with oil exploration. These spills, caused by pipeline leaks, operational failures, and sabotage, have devastating effects on the aquatic life in the region. Oil spills not only pollute water bodies but also disrupt food chains and degrade habitats essential to aquatic species (Aa et al*.,* 2022). Fish and other aquatic organisms exposed to crude oil often suffer from various health complications, including poisoning, decreased reproductive success, and eventual death. The persistent presence of oil in water bodies severely limits the growth and development of aquatic plants, thereby exacerbating biodiversity loss. The decline in fish production in the Niger Delta, which serves as a primary protein source for local communities, is particularly vulnerable to oil contamination, leading to both ecological and socio-economic hardships for the people dependent on these resources (Osuagwu & Olaifa, 2018).

The socio-economic impacts of oil spills are equally dire. Communities in the Niger Delta rely heavily on fishing for livelihoods. When oil spills devastate fish populations, these communities face income losses and food insecurity. The adverse health and environmental effects of oil exploitation in Bayelsa State, a key area within the Niger Delta, have serious economic consequences for the local population (Akagbue et al*.,* 2024). The destruction of aquatic life also affects the broader ecosystem, including species that rely on aquatic organisms for food, such as birds and larger mammals. The socio-economic impact of these disruptions extends to local markets, where fish availability declines, leading to higher prices and food insecurity.

In addition to their direct impacts on aquatic life, the oil industry's activities cause long-term environmental degradation. Abowei (2017) highlighted the persistent contamination of coastal areas, which causes irreversible changes to the natural habitat of numerous species. Oil particles often settle on the seabed, thereby affecting the microbial life that underpins the aquatic food chain. This contamination disrupts ecosystem balance, leading to declines in several species and the proliferation of harmful organisms that thrive in polluted environments. Bamousa et al. (2020) further elaborated on how oil spills negatively affect soil properties in the region, thereby affecting local vegetation and the overall health of the ecosystem.

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One of the most concerning effects of oil spills is the slow recovery of affected ecosystems. Even after visible cleanup efforts, oil residues persist in the environment, continuing to poison aquatic life. According to Igbani et al. (2024), recovery is a slow process that requires years, sometimes decades, for ecosystems to return to their pre-spill conditions. In many cases, full recovery is never achieved, and the long-term impacts are felt for generations.

Mitigation efforts have been implemented in the Niger Delta to address these environmental issues, though they have had limited success. Adeniran (2020) critically assessed the Delta State oil spill management policy, noting that although the government has implemented policies, enforcement remains weak and that the oil industry's actions often disregard environmental safeguards. Additionally, the implementation of bioremediation techniques, such as the use of natural or engineered microorganisms to degrade oil contaminants, has shown promise but is not a comprehensive solution. Adati et al. (2019) and Amadi et al. (2018) emphasised the importance of stronger regulation, enhanced spill response measures, and community involvement in the management and rehabilitation of affected areas.

The devastating effects of oil exploration on the aquatic biodiversity of the Niger Delta cannot be overstated. Oil spills have devastated fish populations, caused long-term environmental degradation, and led to significant socioeconomic challenges for the region's population (Osuagwu & Olaifa, 2018; Abowei, 2017; Igbani et al., 2024). The current efforts to mitigate these impacts, though commendable, need to be bolstered by stricter enforcement of environmental policies, better spill management strategies, and continued research into sustainable practices for oil exploration (Adeniran, 2020; Bello & Nwaeke, 2023). The protection of the Niger Delta's aquatic biodiversity is not only crucial for maintaining the region's ecological balance but also for safeguarding the livelihoods of its people and future generations (Akagbue et al., 2024; Nana, 2023).

The environmental damage caused by oil exploration in the Niger Delta requires urgent attention. A comprehensive approach, involving government action, industry responsibility, and community participation, is essential to prevent further degradation of the region's invaluable aquatic ecosystems (Olukaejire et al., 2024; Tyger & Akujuru, 2021). With concerted efforts, it is possible to mitigate the harmful effects of oil spills and restore the health of the Niger Delta's aquatic biodiversity for the benefit of all (Aa et al., 2022; Ukpene et al., 2024). Therefore, this work aims to study the devastating effects of oil exploration on aquatic biodiversity in the Niger Delta.

Aim of the Study

The aim is to critically study the devastating effects of oil exploration on aquatic biodiversity in the Niger Delta.

Objectives of the Study

The specific objectives of the study are to:

i. Study the overall impact of oil exploration on aquatic biodiversity in the Niger Delta, focusing on habitat destruction, water pollution, changes in water chemistry, disruption of migration patterns, and loss of biodiversity.

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ii. Provide detailed data on major oil spill incidents, specifically in the Bonga and Focados oil spills, and their impact on aquatic biodiversity in the Niger Delta.

Impact of Oil Exploration on Aquatic Biodiversity

A comprehensive study of existing literature relevant to the impact of oil exploration on aquatic biodiversity, particularly within the context of the Niger Delta region. It examines the various dimensions of environmental degradation associated with oil activities, including habitat destruction, water pollution, alterations in water chemistry, and disruption of aquatic life cycles. The section also highlights the ecological consequences of major oil spill incidents, such as the Bonga and Focados spills. This study provides a scholarly foundation for understanding the scope and severity of oil exploration's effects on aquatic ecosystems (Amadi et al*.,* 2018).

Habitat Destruction

Oil exploration in Nigeria's Niger Delta has had profound and far-reaching environmental consequences, particularly for aquatic ecosystems. The Niger Delta, a region rich in biodiversity, is home to diverse aquatic life, including numerous fish species, mangrove forests, and other vital habitats. However, the region has undergone continuous degradation due to oil exploration, extraction, and transportation. The primary environmental consequence of oil exploration in the Niger Delta is habitat destruction, driven by the combined effects of oil spills, deforestation, and environmental pollution.

Oil spills, often resulting from pipeline ruptures, leaks, and improper waste disposal, are the most direct and visible cause of habitat destruction in the Niger Delta. The spills not only contaminate water but also degrade soil and vegetation in surrounding areas. According to a study by Aa et al*.* (2022), oil spills severely affect aquatic environments by smothering aquatic plants and contaminating water sources. This damage impairs the ability of aquatic organisms, including fish, to thrive. The oil often coats fish gills, making it difficult for them to breathe and leading to high mortality rates. Furthermore, the loss of mangrove forests, which serve as critical nurseries for many marine species, significantly reduces biodiversity (Amadi et al*.,* 2018).

The destruction of these habitats is not limited to oil spills alone. The construction of oil drilling infrastructure, such as pipelines, drilling rigs, and access roads, often disrupts natural habitats. These activities result in ecosystem fragmentation, reducing wildlife's available habitat. For instance, Akagbue et al. (2024) reported that the construction of access roads and vegetation clearance for oil exploration activities disrupt the natural balance of aquatic and terrestrial ecosystems in the Niger Delta. This leads to soil erosion, sedimentation in waterways, and species displacement, further degrading habitats.

In addition to direct oil-related activities, ongoing environmental pollution from oil exploration compounds the problem. The release of toxic chemicals and heavy metals into aquatic ecosystems from oil spills and waste disposal contaminates these ecosystems. These pollutants accumulate in the food chain, with devastating effects on marine life and on human populations that rely on aquatic resources for sustenance. Abowei (2017) highlighted that contamination of water bodies affects not only aquatic organisms but also human populations that depend on these

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ecosystems for fishing and agriculture. As aquatic biodiversity declines, the livelihoods of local communities are severely affected, resulting in ecological and socioeconomic repercussions.

The loss of biodiversity in the Niger Delta also disrupts the essential ecosystem services provided by healthy aquatic environments. Mangrove forests, for example, play a crucial role in maintaining coastal stability by preventing erosion and providing a habitat for numerous species. However, oil spills and deforestation have decimated large areas of mangrove forests in the region. The consequences of mangrove loss are far-reaching, as these forests are essential for the life cycles of many fish species, including those important to the local economy. Igbani et al. (2024) argued that the destruction of mangrove habitats and the contamination of water bodies contribute to the decline in fish stocks, which are vital to the food security and income of communities in the Niger Delta.

The devastating effects of habitat destruction are compounded by the slow recovery of ecosystems affected by oil exploration. Oil is a persistent pollutant, and its removal from the environment can take years, if not decades. The long-term environmental degradation caused by repeated oil spills, coupled with slow recovery, makes it difficult for the aquatic ecosystem to regain its previous state of health. Akpoghelie et al. (2021) emphasised that, although promising, bioremediation efforts have not been sufficiently effective in reversing the damage caused by oil spills in the Niger Delta. This further underscore the critical need for comprehensive, effective management strategies to mitigate ongoing environmental damage.

Furthermore, oil exploration in the Niger Delta region has led to conflicts between the oil industry and local communities. As habitats are destroyed, local residents, particularly those who depend on fishing and farming, face diminishing resources and reduced economic opportunities. These tensions often result in social unrest and a deepening cycle of poverty. Ajala (2017) noted that the socio-economic impacts of habitat destruction are far-reaching, affecting the health, livelihoods, and social stability of inhabitants of the Niger Delta. The impact of oil exploration on habitat destruction in the Niger Delta is significant and multifaceted. The ongoing oil spills, deforestation, and environmental pollution have degraded critical aquatic habitats, threatening biodiversity and the livelihoods of local communities. The slow recovery of these ecosystems further exacerbates the problem, underscoring the need for both government and industry to adopt more sustainable practices and policies. To address habitat destruction and restore the health of the Niger Delta's ecosystems, a comprehensive, collaborative approach is necessary. This must involve rigorous oil-spill management practices, restoration of mangrove forests, and strengthened environmental regulations to prevent further degradation of these vital habitats.

Water Pollution

Water pollution is among the most severe environmental issues associated with oil exploration activities in the Niger Delta. The region's aquatic ecosystems, including rivers, lakes, and wetlands, are essential for the livelihood of millions of people who rely on them for fishing, transportation, and agriculture. However, oil exploration activities, including drilling, transportation, and refinery operations, have contaminated these water bodies. The impact of water pollution on aquatic environments is profound, affecting both the biological components of ecosystems and the socioeconomic stability of local communities. Oil spills are the most

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prominent form of water pollution resulting from oil exploration in the Niger Delta. These spills result from pipeline ruptures, equipment failures, and inadequate safety measures. When crude oil is released into the aquatic environment, it spreads across the water surface, forming a film that blocks oxygen from penetrating the water. This disruption depletes oxygen, making it difficult for aquatic organisms, such as fish and invertebrates, to survive. Additionally, oil contaminants may settle on the riverbed, adversely affecting bottom-dwelling organisms and disturbing the natural sediment composition of the water body. The persistence of oil in the environment means that affected waters often take long periods to recover, if at all. This prolonged contamination contributes to the region's long-term ecological degradation (Amadi et al*.,* 2018).

Beyond the immediate damage caused by oil spills, the introduction of hazardous chemicals and heavy metals from oil exploration further exacerbates water pollution in the Niger Delta. Waste materials from oil extraction, such as drilling fluids, produced water, and chemical additives, contain toxic substances that are released into waterways, contaminating aquatic environments. Akpoghelie et al*.* (2021) reported that these substances are harmful to aquatic life and accumulate in the food chain, posing risks to human health. For example, mercury, arsenic, and lead, which are commonly found in the waste products of oil exploration, can accumulate in the tissues of fish and other aquatic organisms, making them toxic for human consumption. This is particularly problematic for the local population, which depends on fish as a primary source of protein.

In addition to oil spills and toxic waste, the discharge of untreated or inadequately treated industrial effluents from oil facilities contributes to the pollution of nearby water bodies. According to Bamousa et al. (2020), these effluents contain elevated levels of hydrocarbons, heavy metals, and other pollutants, which can disrupt the water's chemical balance. The presence of such pollutants harms aquatic organisms by causing reproductive failure, developmental abnormalities, and, in some cases, complete mortality. Moreover, excess nutrients from these discharges can lead to eutrophication, a process in which nutrient overload triggers algal blooms that deplete water oxygen, further harming aquatic life.

The consequences of water pollution in the Niger Delta extend beyond the immediate effects on aquatic life. Polluted water sources affect the health of local populations, as many communities rely on surface water for drinking, cooking, and washing. Contamination of water by oil pollutants increases the incidence of waterborne diseases such as cholera, dysentery, and typhoid fever (Adeniran, 2020). The consumption of water contaminated with oil residues and other toxic chemicals can lead to long-term health problems, including cancers and kidney diseases, among the local population. This exacerbates the already challenging socio-economic conditions in the Niger Delta, where communities suffer from poverty and limited access to healthcare.

Another significant aspect of water pollution in the Niger Delta is its impact on the agricultural sector. Contamination of irrigation water bodies introduces harmful chemicals into the soil, thereby affecting crop production. As a result, farmers in the region experience reduced yields, threatening food security and increasing economic hardship. Igbani et al*.* (2024) emphasised that pollution of water sources also leads to declines in fish stocks, which are a critical source of

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income for many fishermen in the region. The decline in fish populations due to water pollution has far-reaching economic implications for the communities, further exacerbating the socio-economic challenges faced by the people of the Niger Delta.

The persistence of water pollution is compounded by inadequate response measures and regulations to mitigate the damage caused by oil exploration. Despite the significant environmental degradation caused by water pollution, enforcement of environmental regulations and the imposition of penalties on companies responsible for oil spills and pollution remain insufficient. Akagbue et al. (2024) highlighted that the regulatory framework governing oil exploration in Nigeria is weak, and the implementation of measures to prevent or remediate pollution is often lax. This lack of accountability and effective governance allows for continued environmental harm and delays the recovery of affected water bodies. Furthermore, environmental degradation from water pollution has led to conflicts between local communities and oil companies. The Niger Delta region is plagued by tensions between the people, who demand compensation for environmental damage, and oil companies, which often fail to adequately support remediation efforts. As water pollution worsens, these conflicts intensify, leading to social unrest and instability in the region.

Bello and Nwaeke (2023) suggested that addressing water pollution in the Niger Delta requires not only the implementation of stricter environmental policies but also the engagement of local communities in decision-making processes to ensure that their needs are adequately met. Water pollution in the Niger Delta is a major environmental issue with far-reaching consequences for both aquatic ecosystems and the local human population. The impacts of oil spills, toxic waste, industrial effluent discharges, and other pollutants have degraded water bodies, leading to oxygen depletion, biodiversity loss, and contamination of drinking water sources. The long-term effects of water pollution threaten the health, livelihoods, and food security of the Niger Delta's inhabitants. To address this issue, a comprehensive approach that incorporates stricter environmental regulations, effective oil-spill management, and community engagement is needed to restore the region's aquatic environments and protect local populations' well-being.

Changes in Water Chemistry

Changes in water chemistry in the Niger Delta are a significant environmental concern resulting from oil exploration activities in the region. The Niger Delta is an ecologically sensitive area with rich biodiversity and provides essential resources for millions of people who depend on its water bodies for drinking, fishing, and agriculture. However, oil exploration, including extraction, transportation, and refining, has introduced a range of chemical pollutants into these water bodies, resulting in detrimental changes in water chemistry. These changes have far-reaching impacts on both the aquatic ecosystem and the local communities reliant on these water resources. The introduction of oil and its byproducts into aquatic environments is the primary cause of changes in water chemistry. When crude oil spills into rivers, streams, and wetlands, it forms a surface layer that alters the water's natural properties. This oil film impedes gas exchange between the water and the atmosphere, thereby reducing oxygen levels. As a result, the oxygen concentration in the water decreases, making it difficult for aerobic organisms such as fish, crustaceans, and other marine life to survive. Oil spills often lead to the release of toxic compounds, such as polycyclic aromatic hydrocarbons (PAHs) and heavy metals, further

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contaminating water. These substances alter the pH and other chemical properties of the water, making it unsuitable for sustaining a healthy aquatic environment (Adati et al*.,* 2019).

Changes in water pH are a key component of the alterations in water chemistry caused by oil exploration activities. Water bodies in the Niger Delta are often subjected to significant fluctuations in pH levels due to the release of acidic or alkaline substances from oil extraction and refining operations. Oil spills, for instance, can decrease pH, making the water more acidic. Acidification can have serious consequences for aquatic life, as most organisms are adapted to a narrow pH range. For example, fish and invertebrates in the region may experience reduced reproductive success, impaired growth, and, in some cases, death due to the altered pH levels (Tyger & Akujuru, 2021). Moreover, changes in pH can alter the solubility and availability of essential nutrients and metals, further stressing aquatic organisms that rely on environmental stability.

In addition to pH changes, oil pollution introduces elevated concentrations of dissolved hydrocarbons into water bodies, thereby altering water chemistry by reducing dissolved oxygen levels. The presence of hydrocarbons in aquatic environments reduces dissolved oxygen concentrations, a process that is detrimental to both aquatic plants and animals. The reduction in oxygen availability impairs the survival and health of aquatic organisms, particularly fish, which are highly sensitive to fluctuations in oxygen levels. When oxygen levels drop below critical thresholds, the aquatic environment becomes hypoxic, leading to fish kills and ecosystem degradation. In the long term, prolonged exposure to low oxygen levels can shift species composition, favouring the growth of more tolerant species while sensitive species decline or disappear (Amadi et al*.,* 2018).

The introduction of heavy metals into water bodies through oil exploration activities also significantly alters water chemistry. Heavy metals such as mercury, cadmium, lead, and arsenic are commonly found in the waste products of oil extraction and refining processes. These metals are toxic to aquatic organisms and disrupt the ecosystem's chemical balance. Akpoghelie et al. (2021) noted that heavy metals are persistent pollutants that do not degrade over time, thereby accumulating in water bodies and causing long-term environmental contamination. These metals also accumulate in the food chain, affecting not only aquatic organisms but also the local populations that depend on these resources for sustenance. The contamination of fish with heavy metals poses serious health risks to humans, including developmental and neurological disorders, as well as kidney and liver damage.

Another important chemical change in water resulting from oil exploration is the introduction of volatile organic compounds (VOCs), which are released during oil extraction and refining. VOCs, such as benzene, toluene, and xylene, are highly toxic compounds that degrade water quality. These compounds are water-soluble and can have immediate and long-term effects on aquatic environments. VOCs can cause a range of negative effects, including respiratory problems in aquatic organisms, reduced fertility, and behavioural changes in fish. Moreover, these compounds can increase water toxicity, making it unsuitable for other aquatic species to thrive. The continuous release of VOCs into the environment can result in a gradual

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accumulation of toxins in water, leading to biodiversity loss and the collapse of aquatic ecosystems (Amadi et al*.,* 2018).

Changes in water chemistry also alter the biological oxygen demand (BOD) of the water. BOD is an indicator of the amount of organic material in the water that requires oxygen for decomposition. When oil pollutants are introduced into water bodies, they increase BOD by introducing organic compounds that require microbial degradation. The higher the BOD, the more oxygen is consumed during decomposition, thereby reducing the available oxygen for other aquatic organisms. This can create a feedback loop in which low oxygen levels impede the degradation of organic pollutants, resulting in more persistent contamination and prolonged ecological degradation (Osuagwu & Olaifa, 2018).

Changes in water's chemical properties also affect aquatic plants' ability to photosynthesise effectively. The presence of oil on the water's surface blocks sunlight from reaching submerged plants. This inhibits photosynthesis, depriving aquatic plants of the energy required for growth. The reduction in plant life has cascading effects on the entire food web, as plants form the base of the aquatic food chain. The loss of vegetation also destabilises the water's chemical balance by reducing the amount of carbon dioxide absorbed by plants, which is important for maintaining pH stability (Nana, 2023).

Moreover, changes in water chemistry caused by oil pollution have implications for the global climate. The release of methane, a potent greenhouse gas, during oil exploration and extraction processes contributes to climate change. Methane is often released from oil reservoirs and pipelines into the atmosphere, where it contributes to global warming. Although methane is not typically considered a direct water pollutant, its role in altering atmospheric chemistry indirectly affects water chemistry by contributing to global warming, which can lead to temperature fluctuations in aquatic environments. Oil exploration in the Niger Delta has resulted in significant changes in water chemistry, primarily through oil spills, the introduction of toxic chemicals, and the release of heavy metals. These changes lead to reduced oxygen levels, altered pH, and the accumulation of harmful substances in water bodies, thereby adversely affecting aquatic life and the local population that depends on these resources. The introduction of chemical pollutants into water bodies disrupts the delicate ecosystem balance, leading to biodiversity loss, health risks, and economic hardship for local communities. Addressing these changes requires comprehensive policies that regulate oil exploration activities, promote sustainable practices, and ensure effective monitoring and remediation of affected water bodies (Olukaejire et al*.,* 2024).

Disruption of Migration Patterns

Oil exploration in the Niger Delta region of Nigeria has had profound ecological and socio-economic impacts, particularly by disrupting the migration patterns of aquatic and terrestrial species. The Niger Delta, which encompasses numerous wetlands, rivers, and estuaries, is an ecologically sensitive area, home to a diverse range of species that rely on its water bodies and natural resources for survival. Oil exploration and its associated activities, such as drilling, pipeline laying, and refining, have led to widespread environmental degradation. This environmental disruption significantly affects the migration patterns of species that are vital to

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the local ecosystem and economy. The negative effects on migration patterns primarily arise from changes in habitat quality, pollution, and alterations in food availability due to oil spills and gas flaring. One key impact of oil exploration on migration patterns is the disruption of aquatic species' movements. The Niger Delta's riverine and wetland ecosystems serve as critical habitats for numerous fish species, which rely on seasonal migrations for breeding and feeding. However, oil spills, which are frequent in the region, have introduced toxic substances into these waterways, resulting in significant alterations in water quality and chemistry (Amadi et al*.,* 2018).

The presence of hydrocarbons, heavy metals, and other pollutants in water alters the environment's physical and chemical properties, rendering it inhospitable to many aquatic species. These contaminants can interfere with fish migration by blocking natural migration pathways or by causing direct harm to migrating species (Adati et al*.,* 2019). Toxic substances, particularly polycyclic aromatic hydrocarbons (PAHs), are detrimental to fish health and can disrupt reproductive cycles, thereby impairing their ability to migrate effectively. In some cases, fish migration routes are permanently altered when they avoid contaminated areas, leading to population declines in affected regions (Tyger & Akujuru, 2021).

In addition to affecting aquatic species, oil exploration also impacts terrestrial wildlife in the Niger Delta. The construction of oil infrastructure, such as pipelines and drilling sites, often fragments natural habitats and destroys migration corridors used by land mammals, birds, and other terrestrial species. The disruption of these habitats leads to the displacement of wildlife, forcing them to migrate to less suitable areas. The migration of birds and other animals is influenced by the availability of suitable habitats, which are often destroyed by oil activities (Abowei, 2017). Furthermore, the encroachment of oil exploration into pristine environments forces species to adapt to altered conditions, reducing their survival chances and altering their long-distance migration patterns. Oil spills also contribute to the loss of feeding and nesting grounds for migratory birds, which rely on wetlands for breeding and feeding (Olukaejire et al., 2024). A decrease in food availability and habitat quality can cause birds to abandon their traditional migratory routes or to migrate earlier or later than normal, disrupting their biological cycles.

Another critical factor influencing migration patterns in the Niger Delta is the high levels of gas flaring associated with oil extraction. Gas flaring produces large amounts of heat, light, and toxic gases, which can alter the natural environment, hindering animal migration. Gas flaring emits large quantities of sulfur dioxide, carbon dioxide, and particulate matter into the atmosphere, thereby contributing to air pollution and affecting the behaviour of both aquatic and terrestrial species. The noise and light pollution generated by gas flaring have been shown to disrupt the navigation and migratory patterns of certain species, especially those that rely on environmental cues, such as the position of the sun or stars, for long-distance migration (Bello & Nwaeke, 2023). Additionally, greenhouse gas emissions contribute to climate change, which further disrupts migration patterns by altering the timing of seasonal migrations and altering environmental conditions on which species depend for survival (Ukpene et al*.,* 2024).

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The displacement of human populations in the Niger Delta, resulting from environmental degradation associated with oil exploration, also disrupts migration patterns. Local communities that rely on fishing and agriculture for their livelihoods are often forced to relocate due to the adverse effects of oil spills and other forms of pollution. The displacement of human populations can degrade previously unpolluted areas, further affecting wildlife and species migration patterns. The expansion of human settlements into previously pristine areas disrupts the natural environment, leading to habitat loss and further fragmentation of migration corridors. This human-driven disruption compounds the effects of oil exploration on the local ecosystem, making it more difficult for species to adapt to the changing landscape. Oil exploration in the Niger Delta has significantly disrupted the migration patterns of both aquatic and terrestrial species. Pollution from oil spills, habitat destruction, disruption of natural migration corridors, and gas flaring have all contributed to altering traditional migration routes and behaviours. These changes in migration patterns have far-reaching consequences for biodiversity in the region, as species are forced to adapt to less favourable conditions or abandon their traditional migratory paths altogether. Addressing these impacts requires stricter regulations on oil exploration activities, more effective oil-spill management practices, and the restoration of damaged ecosystems to ensure that migration patterns return to their natural state. The preservation of migratory species is crucial not only for environmental health but also for the well-being of communities that rely on these species for their livelihoods (Adeniran, 2020).

Loss of Biodiversity

The impact of oil exploration on biodiversity loss in the Niger Delta is profound and far-reaching. The Niger Delta is one of the world's most biodiverse regions, housing a range of ecosystems, including tropical rainforests, mangroves, freshwater and coastal wetlands, and marine habitats. These ecosystems support a wealth of plant and animal species, many of which are endemic to the region. However, oil exploration activities have significantly contributed to the degradation of these ecosystems, resulting in biodiversity loss. The extraction of oil and natural gas from the Niger Delta involves activities such as drilling, pipeline construction, gas flaring, and frequent oil spills, all of which have direct and indirect effects on the region's biodiversity. The consequences of these activities not only threaten the survival of various species but also the sustainability of the ecosystem services upon which both wildlife and local communities depend. One of the most direct ways in which oil exploration affects biodiversity is through habitat destruction. Oil extraction activities, including the construction of drilling platforms and pipelines, cause significant habitat loss and fragmentation. Wetlands, mangroves, and coastal areas, which are critical habitats for a variety of species, are particularly vulnerable. The destruction of mangrove forests, for example, disrupts the breeding and feeding grounds of many fish species, crabs, and other aquatic organisms. The loss of mangrove forests not only affects the species that inhabit them but also alters the coastal ecosystem, reducing these habitats' capacity to support a diverse range of marine life. Mangroves play a critical role in protecting coastlines from erosion, and their loss further exacerbates the region's vulnerability to environmental degradation (Akpoghelie et al., 2021).

In addition to direct habitat destruction, oil spills are one of the most significant contributors to biodiversity loss in the Niger Delta. The frequent occurrence of oil spills has contaminated soil,

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water, and air, making it difficult for many species to survive in affected areas. Oil spills are particularly harmful to aquatic life, as they coat the water surface, disrupting oxygen exchange and suffocating aquatic organisms such as fish and crustaceans (Igbani et al., 2024). The toxic components of crude oil, such as polycyclic aromatic hydrocarbons (PAHs), are highly persistent in the environment and can cause long-term damage to ecosystems. PAHs are known to disrupt the reproductive systems of fish and other aquatic animals, leading to population declines and reduced species diversity. Furthermore, the accumulation of these toxins in the food chain can affect the health of higher trophic levels, including humans who rely on fish as a primary source of protein (Amadi et al*.,* 2018).

Pollution from oil exploration activities also affects air and soil quality, further threatening biodiversity. Gas flaring, a common practice in oil exploration, emits large quantities of toxic gases, including sulfur dioxide and carbon monoxide, into the atmosphere. These emissions contribute to air pollution and climate change, which, in turn, affect species' migration patterns, reproductive cycles, and health. For instance, air pollution can alter the behaviour of migratory birds and lead to the abandonment of their traditional habitats. Additionally, the deposition of toxic substances on soil can reduce its fertility and affect plant growth, ultimately impacting herbivorous animals that rely on plants for food (Nana, 2023). Pollution-induced changes in plant species composition can also affect animals that depend on them for shelter or food, resulting in cascading negative effects throughout the ecosystem (Bamousa et al., 2020).

The loss of biodiversity from oil exploration is not limited to direct impacts of pollution and habitat destruction. The disruption of local ecosystems also affects the availability of resources for indigenous and migratory species. Oil exploration disrupts the delicate balance of ecosystems, reducing the availability of food sources and breeding grounds for various species. In particular, fish species that rely on wetlands for spawning and feeding are severely affected by degraded water quality and habitat loss. As biodiversity declines, ecosystem resilience to environmental stressors diminishes, making it more difficult for ecosystems to recover from additional disturbances, such as climate change and invasive species (Akagbue et al*.,* 2024).

In addition to the ecological impacts, the loss of biodiversity in the Niger Delta has significant socio-economic consequences for local communities. The Niger Delta is home to numerous ethnic groups that depend on the region’s biodiversity for their livelihoods. Many communities rely on fishing, farming, and hunting as their primary sources of income. As biodiversity declines, these communities face the loss of valuable resources, leading to economic hardship. The reduction in fish populations, for example, not only affects local diets but also results in the loss of income for fishermen who depend on the region’s aquatic life for their livelihoods. Similarly, the destruction of agricultural land and loss of plant species reduces the availability of food and medicinal plants for local communities. This exacerbates poverty and increases these communities' vulnerability to other forms of environmental degradation (Olukaejire et al*.,* 2024).

Furthermore, biodiversity loss in the Niger Delta affects the cultural practices of indigenous communities. Many traditional practices, such as festivals and rituals, are closely linked to the region’s natural resources and biodiversity. The loss of species integral to these cultural practices can erode cultural heritage and identity, further deepening the social impacts of oil exploration.

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As biodiversity diminishes, the sense of place and connection to the land that is central to the identity of these communities is lost, further marginalising indigenous peoples. Oil exploration in the Niger Delta has led to significant biodiversity loss, driven by habitat destruction, pollution, and the disruption of ecosystem functions. The degradation of the region's wetlands, mangroves, and marine environments has had lasting effects on species populations, and the loss of biodiversity has far-reaching consequences for both the environment and local communities. To mitigate these impacts, it is crucial for policymakers to implement stricter regulations on oil exploration activities, promote environmental remediation, and work toward restoring the health of the Niger Delta ecosystem. Ensuring the survival of biodiversity in the region is essential not only for ecological stability but also for the well-being of the people who rely on these resources for their livelihood (Ajala, 2017).

Bonga and Focados Oil Spills in the Niger Delta

The Niger Delta, one of the most oil-rich regions in the world, has been the epicentre of major oil spills that have resulted in severe environmental, economic, and social consequences. Among the most notable cases are the Bonga oil spill of 2011 and the Focados oil spill of 2016. These incidents have become case studies for understanding the devastating impact of oil exploration and the associated operational failures in the region.

The Bonga Oil Spill (2011)

Umejei (2023) reported on their work of resistance from the Global South: Nigerian Press Coverage of Bonga Oil Spill Controversy. The Bonga oil spill occurred when Shell's export line linking its Floating Production Storage and Offloading (FPSO) vessel at the Bonga deep offshore ruptured and spewed crude oil into the sea. The vessel discharged approximately 40,000 barrels (some 6.4 million litres) of crude oil into the sea, prompting the National Oil Spill Detection and Response Agency (NOSDRA) to impose a $3.6 billion levy on Shell as compensation for environmental damage. They noted that Shell resisted paying the compensation and sought judicial interpretation of whether the NOSDRA had the constitutional legitimacy to impose sanctions on it. They draw on framing theory and Norman Fairclough's three-dimensional model of critical discourse analysis (CDA)as an analytical framework of the discourse of environmental (in)justice in five Nigerian newspapers, such as (N = 45), *ThisDay* (N = 6), *Premium Times* (N = 9), and *Punch* newspaper (N = 2). The findings suggest that the Nigerian Press provided a forum for victims of the Bonga oil spill, including communities, government agencies, and civil society activists, to hold Shell to account for its role in the "destruction of geographies" of the Global South.

On December 20, 2011, a major oil spill occurred at the Bonga offshore oilfield, operated by Shell Nigeria Exploration and Production Company (SNEPCo), approximately 120 kilometres off the Nigerian coast. The spill released approximately 40,000 barrels of crude oil into the Atlantic Ocean during a routine operation to transfer oil from a floating production vessel to a tanker (Abowei, 2017). Though offshore, the spill quickly spread toward the coastline due to strong ocean currents, affecting coastal communities in Delta and Bayelsa States.

The environmental impact of the Bonga spill was extensive. The spill contaminated vast stretches of coastline, killing marine organisms and damaging sensitive ecosystems, including

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mangrove forests, beaches, and wetlands (Aa et al*.,* 2022). Many communities reported dead fish washing ashore, oil-stained water, and foul odours. The incident disrupted fishing activities, a major livelihood in the region, for months. Osuagwu and Olaifa (2018) noted that the spill contributed to a significant reduction in fish catches, particularly affecting artisanal fishermen whose livelihoods depend on nearshore fishing grounds. Despite Shell's claims that the spill occurred offshore and did not reach the shorelines, multiple independent assessments confirmed contamination in coastal areas. The socioeconomic implications were substantial. Communities dependent on fishing and farming reported declining incomes, food insecurity, and deteriorating health conditions due to oil exposure. Ajala (2017) emphasised that the lack of timely compensation and cleanup exacerbated local frustrations, contributing to growing distrust between oil companies and host communities.

The Focados Oil Spill (2016)

The Focados oil spill occurred in February 2016, following the rupture of the Focados export pipeline operated by Shell's Nigerian subsidiary. The pipeline, located in the western Niger Delta, is a major crude oil transportation route. The spill discharged large volumes of crude oil into the surrounding creeks and mangrove swamps of Delta State. This pipeline failure resulted in contamination of vast tracts of farmland, fishing ponds, and river systems (Amadi et al*.,* 2018).

Unlike the Bonga spill, the Focados spill had a direct impact on terrestrial and aquatic ecosystems, further damaging local communities. Reports indicated widespread destruction of crops, contamination of drinking water sources, and mass fish deaths. Akagbue et al. (2024) observed that residents' health was affected by increased exposure to toxic hydrocarbons, resulting in respiratory illness, skin diseases, and gastrointestinal disorders.

The response to the Focados spill drew criticism from environmental groups and civil society. Many stakeholders condemned the slow and inadequate remediation efforts, the lack of transparent impact assessments, and the absence of community participation in the response process. Adeniran (2020) noted that the failure of oil companies and government agencies to enforce existing environmental regulations contributed to recurring spills and public discontent. The Focados spill highlighted weaknesses in Nigeria's oil spill response framework and the need for reforms that prioritise environmental protection and community welfare. Both the Bonga and Focados oil spills underscore the persistent risks posed by oil exploration in the Niger Delta and the failure of stakeholders to prevent or respond effectively to environmental disasters. These spills had common consequences, including biodiversity loss, contamination of water and soil, and disruptions to livelihoods. Oil spills alter soil composition and water chemistry, rendering agricultural lands infertile and aquatic habitats uninhabitable. In both cases, recovery was slow, and the long-term ecological damage continues to affect the region (Bamousa et al*.,* 2020).

Moreover, the case studies reveal the regulatory shortcomings in Nigeria's environmental management system. Bello and Nwaeke (2023) stated that despite the existence of environmental protection laws, enforcement remains weak due to corruption, lack of political will, and limited technical capacity. This regulatory failure allows oil companies to operate with impunity, often prioritising profits over environmental responsibility. The spills also illustrate the disconnect

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between oil companies and local communities. Inadequate compensation, lack of transparency in cleanup processes, and exclusion from decision-making processes contribute to social tensions and resistance. Nana (2023) and Olukaejire et al. (2024) stressed that any meaningful effort to prevent future spills must include community engagement, capacity building, and accountability mechanisms for oil operators.

Projected Mitigation Measures

Pascal et al. (2013) observed that environmental degradation in the Niger Delta is a complex issue driven by factors such as oil spills, gas flaring, deforestation, and inadequate regulatory frameworks. He stressed that the effects of this degradation are profound, impacting local health, livelihoods, biodiversity, and overall community stability. Nwachukwu et al. (2025) suggested some mitigation measures, such as:

i. Enforcing regulations,

ii. Promoting sustainable practices,

iii. Engaging communities and investing in clean technologies is crucial for addressing both the causes and effects of environmental degradation.

v. By adopting a multi-faceted approach that involves local communities, government, and the private sector, the Niger Delta can work towards a more sustainable future with a healthier environment.

The commitment to implementing these measures will be essential in reversing the damage done and preserving the rich natural and cultural heritage of the Niger Delta for future generations. Nevertheless, an oil-spilt ecosystem requires a biodegradable cleanup method to support aquatic restoration and the restocking of lost biodiversity, thereby promoting sustainable environmental livelihoods.

Conclusion

The persistent occurrence of oil spills in the Niger Delta has significantly contributed to environmental degradation, biodiversity loss, and socio-economic hardship for local communities. Despite the region’s wealth of petroleum and gas resources, it is disheartening that weak regulatory enforcement, inadequate response mechanisms, and neglect of affected populations have exacerbated the negative impacts. This underscores the urgent need for sustainable oil exploration practices, robust policy implementation, and inclusive environmental governance. Without decisive action, the ecological integrity and livelihoods in the Niger Delta will continue to deteriorate, undermining national development and environmental sustainability goals. The Niger Delta region cries for environmental justice.

The Niger Delta region of Nigeria is regarded as a reservoir for oil and gas exploration and exploitation. Oil and gas have remained the backbone of the Nigerian economy, accounting for over 90% of the country’s foreign exchange revenue. Despite the region's enormous resources and substantial revenues, the benefits have barely reached the Niger Delta: it is marked by

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deprivation, underdevelopment, and unemployment, with the majority of its people living in poverty. Similarly, the environment is severely degraded by crude oil spills during exploitation and transportation, as well as by oil leaks from obsolete pipelines with delayed remediation. The development of the area has remained a major challenge for the Nigerian State, with local communities expressing their dissatisfaction with Government efforts. Hence, exploration activities, which have largely been unsustainable, have led to the region's deterioration, with marked effects on land degradation, water pollution, and mangrove loss due to oil spills. The effects have subsequently created restiveness among the youth and a crisis between the youths of the region and the Nigerian Government. Establishment of spill centres along coastlines, undertaking actions to minimise risk of oil spills, elimination of gas flaring and more importantly, supervision of the conduct of oil companies licensed to explore oil in the region, implementation of development programmes, provision of infrastructure and basic amenities, among others, have been noted to bring about sustainable development and stability in the region.

Recommendations

In light of the devastating environmental and socio-economic consequences of oil spills in the Niger Delta, it is imperative that multi-stakeholder interventions be prioritised to curb recurring ecological degradation, thus:

- The government should enforce stringent environmental regulations that compel oil companies to prioritise safety and environmental stewardship and justice.
- Oil companies must be held accountable for timely and effective clean-up operations following any spill.
- Local populations must be empowered through sustained public awareness campaigns, fair and prompt compensation for damages, and the implementation of livelihood restoration programmes.
- Independent regulatory bodies should be strengthened and properly funded to monitor oil industry practices, ensure compliance with environmental standards, and enforce penalties for violations.
- Multi-national oil companies should adhere to their environmental management systems.

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