

Impact of Drilling Activities on Local Ecosystems and Communities in Nigeria

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Abstract

Original Research Article

For many years, oil and gas drilling has been a centerpiece of Nigeria's economy and has contributed to national revenue generation, foreign exchange earnings, and infrastructural development in the country. At the same time, however, such drilling activities are associated with environmental and socio-economic consequences that have raised increasing concern among host communities within ecologically sensitive regions. The research will discuss how drilling activity has affected local ecosystems and communities within Nigeria through the lenses of environmental degradation and biodiversity loss, public health effects, and socio-economic disruptions. A mixed-methods research approach is being adopted for this study, consisting of field questionnaires, key informant interviews, and analysis of secondary data, all of which can be used to measure the level and type of impacts from drilling. Primary data for the research were gathered among the residents of oil-producing communities, environmental officials, and community leaders, while the secondary data were obtained from government reports and the peer-review literature. This allows the full comprehension of both environmental and social dimensions of drilling operations. Findings from the study indicate that drilling activities significantly contribute to the degradation of soil and water through oil spills, waste discharges from drilling operations, and gas flaring. The study concludes that while oil and gas drilling remains economically important to the country, inadequate environmental governance, weak regulatory enforcement, and poor community engagement significantly heighten its adverse effects. It thus calls for increased implementation of environmental regulations, introduction of environmentally friendly drilling technologies, and community involvement in decision-making as a way of curtailing long-term ecological and social damage.

Keywords: Drilling activities, Ecosystem degradation, Host communities, Oil and gas, Nigeria

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1. INTRODUCTION

Nigeria is Africa's largest oil producer and one of the world's leading exporters of crude oil, with petroleum resources concentrated predominantly in the Niger Delta region (Ita et al., 2019). The discovery of commercial quantities of crude oil

in Oloibiri in 1956 marked a turning point in Nigeria's development trajectory, positioning petroleum as the backbone of the national economy. Since then, oil exploration and production activities have expanded rapidly across onshore and offshore locations, profoundly shaping the country's economic

growth, political priorities, and governance structures. Oil revenues have contributed significantly to national income, foreign exchange earnings, and public expenditure. However, this economic dependence on petroleum has also entrenched structural vulnerabilities and intensified environmental pressures, particularly in oil-producing communities (UNEP, 2023).

Drilling activities encompass a range of processes, including seismic surveys, exploratory drilling, appraisal drilling, and full-scale production operations, all of which exert varying degrees of stress on the natural environment. These activities frequently involve extensive land clearing, construction of access roads and pipelines, disposal of drilling muds and cuttings, routine gas flaring, and accidental or operational oil spills (Ebegbulem et al., 2013). In ecologically sensitive environments such as mangrove swamps, wetlands, rivers, and coastal ecosystems, these disturbances disrupt soil quality, contaminate water bodies, and degrade habitats that support diverse plant and animal species. Over time, the cumulative impacts of these activities have resulted in biodiversity loss, reduced ecosystem resilience, and diminished ecosystem services such as flood regulation, water purification, and carbon sequestration.

The environmental consequences of drilling activities extend beyond physical degradation to include long-term public health risks. Contamination of surface and groundwater sources with hydrocarbons and heavy metals poses serious threats to human health, increasing the incidence of waterborne diseases, respiratory conditions, and other pollution-related illnesses in host communities (UNEP, 2023). Gas flaring, in particular, contributes to air pollution and greenhouse gas emissions, exacerbating climate change while simultaneously undermining local air quality and agricultural productivity.

In addition to environmental impacts, oil drilling activities have significantly affected the socio-economic well-being of communities in oil-producing areas. Traditional livelihoods such as fishing, farming, and hunting, which are heavily dependent on a healthy environment, have been increasingly compromised by oil pollution, soil infertility, and declining fish stocks (Okoye &

Afolayan, 2020). As a result, many households experience reduced income, food insecurity, and heightened poverty levels. Furthermore, perceptions of marginalization, inadequate compensation for environmental damage, weak corporate social responsibility initiatives, and limited community involvement in decision-making processes have intensified grievances among local populations. These issues have contributed to recurrent conflicts, protests, and insecurity in the Niger Delta, straining relationships between oil companies, government institutions, and host communities (Ogugbuaja et al., 2024).

Despite the existence of environmental regulations, monitoring agencies, and environmental impact assessment (EIA) frameworks designed to mitigate the adverse effects of oil drilling in Nigeria, enforcement has remained inconsistent and largely ineffective. Institutional capacity constraints, regulatory overlap, political interference, and limited transparency have allowed environmentally harmful practices to persist (NESREA, 2024). Consequently, the gap between policy intent and on-the-ground implementation continues to undermine sustainable resource governance.

2. LITERATURE REVIEW

2.1 Drilling Activities and Environmental Degradation

There are numerous literature reports emphasizing the negative impacts of oil and gas drilling on the environment, especially in developing nations with very poor regulatory systems in place (Hatefi et al., 2023). The drilling processes tend to result in the input of petroleum, heavy metals, and drilling fluids into soil and water bodies, thus causing pollution (Hatefi et al., 2023). In Nigeria, improper disposal and leakage from drilling activities are reported to contribute immensely to pollution (Okale et al., 2023).

Gas flaring in the oil fields of Nigeria has been known to emit greenhouse gases and harmful substances such as sulfur dioxide and nitrous oxide, leading to global warming and acid rains (World Bank, 2023). It has been known to affect the entire atmosphere, soil, and vegetables.

2.2 Impact on Biodiversity and Ecosystem Services

Ecological systems in oil-producing areas, especially mangrove forests, wetlands, and fresh water systems, offer elementary ecosystem services critical in sustaining environmental stability and human well-being. The services offered include flood regulation, shoreline protection, carbon sequestration, nutrient cycling, and the provision of breeding and nursery habitats for a wide array of aquatic and terrestrial species. In Nigeria's Niger Delta, mangrove ecosystems serve to importantly buffer coastal communities against erosion and flooding while supporting fisheries that sustain local livelihoods.

However, these sensitive ecosystems have been severely disrupted by a number of drilling-related disturbances, including deforestation for infrastructure development, seismic surveys, access routes and pipelines, routine gas flaring, and oil contamination. Vegetation removal and recurrent exposure to pollutants alter the structure of soil and water, impair the natural regeneration process, and reduce overall ecosystem resilience. Such chronic hydrocarbon pollution due to spilled oil further degrades habitats, which causes physiological stress and mortality among plant and animal species, weakening ecosystem functionality over time.

Empirical research undertaken in the Niger Delta shows that there are significant decreasing trends in fish stock, reduced species, and extensive loss of mangrove forests that are directly associated with oil exploration and pollution activities on the environment (Bello et al., 2019). Destruction of aquatic ecosystems has been responsible for decreasing fish catches and the extinction of delicate species, which indicate an imbalanced ecosystem. Destruction of biodiversity is associated with risks of unsustainability of environmental ecosystem integrity, in addition to heightened risks of food insecurity, poverty, and erosion of the culture of communities that largely depend on the environment for their survival. In the long term, deteriorating ecosystems expose communities to environmental hazard risks, thereby perpetuating environmental socio-economic marginalization in oil-producing communities.

2.3 Socio-Economic and Health Impacts on Host Communities

The local populations in regions with oil-producing companies experience a higher burden in relation to the negative environmental and health impacts caused by drilling, despite having minimal direct benefits from resource exploitation. Long-term consequences from contaminated water, soil, and poor air quality in drilling regions were found to contribute to a high rate of cases from respiratory problems, skin infections, and gastrointestinal diseases caused by pollution (Obi et al., 2021). The negative environmental and health problems can be attributed to a lack of access to proper health services in most regions where drilling companies operate, and this increases the overall negative impact on health and wellbeing. The most affected populations in this situation are children and both the elderly and expecting mothers, who are highly susceptible to poor environmental health.

From a socio-economic point of view, drilling operations often interrupt and undermine indigenous economic ways of living, which include fishing, farming, and small business retailing, without offering a suitable compensatory source of employment for the affected locals (Olujimi & Bello, 2021). The degradation of the environmental base further leads to a reduction in the productivity of farmland and fish populations, causing lost incomes, unemployment, and increased poverty among the host population. Although the oil companies set up projects aimed at ameliorating the host environments, which include building infrastructure, offering scholarships, and running healthcare programs, such measures are generally viewed as inadequate in size, irrelevant in terms of indigenous need, and non-remunerative in the long term (Gbali et al, 2021). The lack of community participation in the implementation of projects further diminishes any potential positive impacts, hence maintaining a sense of indifference and inequality among the affected host populations, the oil corporation, and the governmental authorities in relation to one another.

2.4 Regulatory Framework and Governance Challenges

The Nigerian government has developed various environmental laws and initiatives intended to regulate the impacts of the oil drilling operations. The major ones include the Environmental Impact Assessment Act, the environmental guidelines in the petroleum sector, and the regulations provided by the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the Nigerian Upstream Petroleum Regulatory Commission. These laws provide the framework that oversees the environmental assessment of oil drilling operations, employs pollution control, and is also in line with international environmental standards.

Despite the presence of such regulations, their effectiveness has largely been undermined by challenges such as deficiencies in enforcement, overlapping regulations, corruption, and the technical and financial capacity necessary for monitoring and compliance (Audu et al, 2024). Notably, environmental impact assessments have largely become procedural rather than substantive in their application and use for environmental protection, resulting in unsuccessful implementation in mitigation measures and monitoring after completion of projects. This is due to the absence of severe measures being levied on environmental offenders who engage in pollution activities such as gas flaring and disposal of waste without regard.

Scholars and policy analysts, therefore, suggest that for environmentally sustainable oil and gas operations in Nigeria to be achieved, it shall take more than the presence of regulatory frameworks; it demands the building up of institutional accountability, transparency, and coordination between regulatory bodies. Equally essential is the meaningful involvement of host communities in the process of environmental governance, including decision making, monitoring, and grievance procedures. Increased participation by communities would enhance local level governance, build trust, and help better align environmental management strategies with the real-life concerns of affected populations. Collectively, these steps are

considered pivotal to addressing the lapses between policy intention and actual environmental protection in Nigeria's oil and gas industry.

3. METHODOLOGY

3.1 Research Design

The design followed was an explanatory sequential design type, which specifically involves mixing methodology from both quantitative and qualitative paradigms. The design started with a quantitative step, which involves conducting household surveys to establish general trends or statistical relationships between variables concerning perceived degradation, loss of livelihoods, health outcomes, or socio-economic disruptions. The design followed a qualitative step that involves key informant interviews or field observation to explain what lies behind the quantitative findings. This design permits triangulation, which provides validity to every design.

3.2 Study Area

A total of 12 communities were chosen purposively in four states within the Niger Delta region, namely Bayelsa, Rivers, Delta, and Akwa Ibom states, where there is intensive drilling activities for crude oil and concomitant environmental problems such as high incidences of oil spills, gas flaring, and mangrove destruction. The criteria for selecting these communities took into consideration the previous incidences of oil spills, their adjacency to operational oil facilities such as oil pipelines and flow stations, their dependence on fishing and agriculture, and levels of pollution severity.

3.3 Sampling

A mix of probability and non-probability sampling methods was used:

- i. Multi-stage cluster sampling to get household heads: The clustering technique used communities grouped by state and local government Area. This gave a sample of 478 household heads (which has enough power for quantitative analysis).
- ii. Purposive key informant sampling: The participants were selected based

on their relevance, such as leaders, women/youth leaders, fishermen, environment officers, and health

personnel. A total of 41 key informants were selected.

The table below summarizes the sampling breakdown:

Sampling Technique	Target Group	Sample Size	Rationale/Criteria
Multi-stage cluster	Household heads	478	Representativeness across communities
Purposive	Key informants	41	Expertise in local environmental/health issues
Total		519	

3.4 Data Collection Instruments

Several tools were employed to gather data from different sources:

- i. Questionnaire administered in the homes: Involved both closed-type (5-point Likert scale on perceived severity and open-ended inquiries. Revealed home environments, changes in livelihood, self-reported illnesses, and perceptions of compensation.
- ii. Semi-structured guide to the interview: Employed with key respondents to explore complex explanations, historical information, coping mechanisms, perceived causes.
- iii. Checking field observation by GPS-linked photos of oil slick on water surface, death of vegetation, flared locations.
- iv. Review of secondary documents: Analyses of spill reports, Joint Investigation Visit (JIV) reports, environmental audits, and official NGO documents for verification.

3.5 Data Analysis

- i. **Quantitative analysis:** Quantitative data were analyzed using SPSS v.27.

Techniques included descriptive statistics-frequencies, percentages, means-and inferential statistics-chi-square tests for associations and Pearson/Spearman correlation in relationships between variables such as pollution exposure and health/livelihood outcomes.

- ii. **Qualitative data:** Thematic analysis was done in NVivo by combining inductive and deductive approaches to code emergent themes from the data, and pre-defined codes were taken from the literature, respectively. Themes will include degradation perceptions, livelihood collapse, health burdens, and distrust in institutions.

3.6 Ethical Considerations

Approval from the ethical committee involving the study was sought before the data was collected. All aspects of the research were conducted following the already established ethical guidelines to ensure the well-being and respect of the rights and dignity of the participants. Informed consent from the participants of the study had been sought through either written or verbal means. If need be, information had been provided in the local language to communicate the comprehension of

the study. All the participants of the study had been guaranteed their right to remain anonymous and that their information had been treated confidentially. All personal information from the participants had been eliminated from the results. Participation in the study had also remained voluntary. The participants had been well-informed of the right to oppose participation and withdrawal from the research study without any dire consequences. Within the research process, the aspects of the culture of the place had also been taken into consideration. This especially appeared during the time of the interview. Furthermore, there had been no material aspect of the study that had acted to coerce anyone to take part in the study.

4. RESULTS

The findings reveal severe, multi-dimensional impacts of oil-related activities (spills, gas flaring, and infrastructure) on the environment, biodiversity, livelihoods, health, and social fabric in the studied communities. Percentages are derived from the household survey (n=478), with qualitative insights providing explanatory context.

4.1 Perceived Environmental Degradation

Households overwhelmingly reported acute and chronic pollution. High percentages indicate widespread consensus on severity.

Environmental Issue	Perceived as Serious to Very Serious (%)	Key Qualitative Insights
Contamination of streams/rivers	78.4	Oil sheen, dead fish, unusable water sources commonly observed
Long-term damage to farmland soil	71.9	Soil infertility, reduced fertility persisting years after spills
Dramatic reduction in mangrove/fishery resources	82.6	Extensive die-back of mangroves, loss of breeding grounds
Visible evidence of continuous gas flaring (within/near community)	67.3	Heat, soot, acid rain effects; flares visible day/night

4.2 Biodiversity and Livelihood Losses

Occupational groups reported stark declines, consistent with ecosystem collapse in mangrove and wetland areas.

- Fishermen:** 79.1% reported >50% reduction in catch compared to 15 years ago (e.g., smaller sizes, fewer species).
- Farmers:** 64.8% reported major decline in crop yield (cassava, plantain, vegetables), linked to soil contamination and acid rain from flaring.

Specific biodiversity losses (reported disappearances/dramatic reductions):

- Periwinkles, oysters, tilapia, catfish, crabs, mudskippers.
- Several mangrove-associated bird species.

These align with broader patterns of mangrove mortality and fishery collapse in the region.

4.3 Health Consequences (Self-Reported – Last 5 Years)

Self-reported symptoms were prevalent, particularly among women and those near flare/spill sites. These reflect exposure to hydrocarbons, heavy metals, and air pollutants.

Health Issue (Self-Reported)	Prevalence (%)	Notes/Qualitative Context
Increased respiratory problems	61.2	Cough, asthma-like symptoms, exacerbated by flaring/soot
Frequent skin rashes/sores	54.7	Dermatitis from contaminated water/contact
Frequent eye irritation	47.9	Redness, burning from air pollutants/gas flaring
Higher rate of miscarriages/stillbirths (women respondents)	38.4	Linked to chronic exposure; higher among women near sites

Additional qualitative reports included headaches, fatigue, and suspected long-term risks (e.g., cancers), though not quantified here.

4.4 Socio-economic Disruption

Pollution has eroded traditional livelihoods, deepened poverty, and fueled institutional distrust.

Socio-Economic Indicator	Percentage (%)	Key Insights
Complete or partial loss of previous primary livelihood	69.4	Shift to menial jobs; many unable to fish/farm productively
Household income worse than 10 years ago	58.7	Reduced yields/catches; rising costs for alternatives
Believe oil companies do not fairly compensate for damage	73.1	Inadequate/ delayed payments; corruption allegations
Very high or high level of distrust toward oil companies	81.6	Perceived negligence, broken promises, lack of remediation

In total, the results portray a region facing cascading crises: ecological collapse drives livelihood failure, which exacerbates health burdens and socio-economic marginalization, compounded by perceived governance failures. These findings underscore the urgent need for comprehensive remediation, fair compensation, and sustainable alternatives.

5. CONCLUSION

The study shows that the effects of drilling in Nigeria are of a large magnitude and of a

negative impact on the ecosystem of Nigeria, especially in regions that produce petroleum, such as Niger Delta. Findings from the research suggest that environmental degradation in land, water, biodiversity, and ecosystem service depletion is a major environmental issue on a large scale in Nigeria. These environmental factors are very closely associated with health effects, such as an increase in diseases; reduced agriculture; depletion of fish; and loss of traditional resources. Despite having proper environmental policies and frameworks in place,

these factors are unabated in Nigeria, which is an indication of a large gap between these policies and their implementation. All in all, these findings suggest that a sustainable, community-focused, and responsible approach is largely needed to address drilling activities in the petroleum sectors of Nigeria.

5.1 Recommendations

- i. **Enforcement of Environmental Regulation:** The regulatory bodies in the government should improve their mechanisms in relation to monitoring and compliance with a view to ensuring that all oil companies respect the law and regulatory standards in the petroleum industry. This will ensure that sanctions are meaningful and can be a deterrent to companies with negative behavior against the environment.
- ii. **Adoption of Cleaner Technologies:** Energy extraction firms must focus on embracing cleaner technologies that will reduce environmental degradation through drilling processes. Adoption of cleaner technologies in drilling oil and gas will result in a decrease in emissions and reduction in the destruction of ecosystems. Adoption of appropriate technologies in waste treatment will also play a significant role in addressing this issue.
- iii. **Community Participation:** It is essential that the local communities participate in the decision-making process that involves drilling projects. It is increasingly important to ensure that local concerns and local knowledge inform the management of the environment. Local community participation can help to ensure that transparency in projects is achieved.
- iv. **Enhanced Health and Livelihood Support:** Specific public health initiatives need to be rolled out in order to cater to the health issues posed by pollution in the regions where oil is produced, in addition to providing better access to health care. Furthermore, initiatives in diversifying livelihoods and upgrading skills need to be launched in

favor of affected sectors in an effort to reduce reliance on livelihoods that are highly susceptible to environmental degradation.

- v. **Regular Environmental Audits:** There should be regular, objective, and transparent environmental audits that review the short and long-term environmental effects of drilling. The findings of such audits should be shared with the public and should help in making improvements in the environmental management practices of the oil industry.

Collectively, this offers a guideline in lessening negative effects emanating from drilling activities and encouraging a more environmentally sustainable approach to operations and better host community welfare in Nigeria.

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