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Environmental impact analysis of oil and gas operations in Nigeria: Implications for sustainable operational strategies of international firms

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Abstract
Environmental impact analysis of oil and gas operations in Nigeria has become a critical issue in sustainability discourse due to the extensive ecological degradation, social disruption, and health risks associated with petroleum activities in the Niger Delta. Despite the sector's significant contribution to national revenue since the discovery of oil in Oloibiri in 1956, persistent challenges such as oil spills, gas flaring, deforestation, water contamination, and biodiversity loss continue to undermine environmental quality and community livelihoods. Weak regulatory enforcement, inadequate baseline data, and poor implementation of Environmental Impact Assessments (EIA) further limit effective environmental mitigation. This study examines the role of environmental impact analysis in shaping sustainable operational strategies of international oil firms operating in Nigeria. Anchored on Stakeholder Theory and Sustainable Development Theory, the study highlights the importance of balancing economic objectives with environmental protection and social responsibility. Findings from existing literature indicate that improved environmental performance and sustainability investments enhance operational efficiency, financial returns, and corporate reputation. The study identifies key sustainable operational strategies, including strengthening EIA quality, adopting cleaner technologies, implementing integrated environmental monitoring systems, promoting community participation, aligning with ESG frameworks, investing in environmental remediation, and adopting responsible decommissioning practices. The study concludes that environmental impact analysis is no longer a regulatory formality but a strategic tool for achieving long-term operational sustainability. It recommends that international oil firms integrate rigorous environmental assessment processes into operational planning to reduce ecological harm, improve stakeholder trust, and enhance long-term competitiveness in Nigeria's evolving energy landscape.

Keywords: Environmental impact analysis, environmental impact assessment (eia), oil and gas operations, sustainability, niger delta

Introduction

Environmental impact analysis of oil and gas operations in Nigeria has become central to debates on sustainability, justice, and corporate strategy, especially for international firms operating in the Niger Delta. Since oil was discovered at Oloibiri in 1956, petroleum has underpinned Nigeria's economy, accounting for the bulk of export earnings and government revenue, yet this growth has been accompanied by extensive environmental degradation, social disruption, and conflict in host communities (Ite *et al*., 2024; James *et al*., 2022; Akeju & Oguntimein, 2023) [2, 14, 17]. Oil spills, gas flaring, deforestation, loss of mangrove ecosystems, contamination of land and water, and associated health risks such as respiratory illness and cancer are widely documented in the Niger Delta, where thousands of spill incidents and persistent flaring have undermined livelihoods and biodiversity (James *et al*., 2023; Ite *et al*., 2024; James *et al*., 2022; Akeju & Oguntimein, 2023) [2, 14, 17, 18]. Weak enforcement of environmental regulations, inadequate baseline data, and poor implementation of Environmental Impact Assessments (EIA) mean that legal requirements often do not translate into effective mitigation on the ground, and many EIAs are produced mainly to secure permits rather than to guide environmentally sound decision-making (Anifowose *et al*., 2016; Ingelson & Nwapi, 2014) [3, 4, 11].

Systematic quality reviews of Nigerian oil and gas Environmental Impact Statements highlight deficiencies in impact prediction, decommissioning planning, and follow-up, underscoring the need for more rigorous, transparent, and participatory assessment processes. At the same time, growing global and domestic pressure, from climate policy, investor scrutiny, and community activism is pushing oil and gas companies to adopt more robust environmental, social, and governance (ESG) practices, and evidence from Nigeria shows that better environmental performance and sustainability investments can enhance financial performance, operational efficiency, and risk-adjusted returns (Oruwari *et al*., 2025; Okey *et al*., 2025; Emmanuel, O., & Mary, 2022; Bamishe, O., & Adegbie, 2024; Akande, 2025) [1, 6, 8, 22, 23].

For international oil companies, these dynamics have strategic implications: environmental impact analysis is no longer a compliance formality but a core input into sustainable operational strategies, shaping choices about technology, location, community engagement, and eventual exit or divestment (James *et al*., 2023; Oruwari *et al*., 2025) [23] [18]. Frameworks that integrate systems thinking, environmental conservation costs, CSR, and business sustainability models offer pathways for aligning global climate commitments with local environmental protection and community welfare, providing international firms with tools to reduce ecological harm while safeguarding long-term competitiveness in Nigeria's evolving energy landscape (Ite *et al*., 2024; Akande, 2025) [1, 14].

Theoretical Review

This work was built on stakeholder theory and sustainable development theory. Stakeholder Theory was propounded by R. Edward Freeman in 1984 as a framework for

understanding how organisations create value for multiple stakeholders rather than shareholders alone. The theory assumes that organisations are accountable to all parties affected by their operations, including employees, customers, host communities, regulators, investors, and the natural environment. It posits that long-term organisational success depends on balancing and integrating the interests of these stakeholders (Emmanuel & Mary, 2022; Oruwari *et al*., 2025) [8, 23]. The theory further assumes that ignoring stakeholder concerns can lead to conflict, loss of legitimacy, and poor performance. In relation to the environmental impact analysis of oil and gas operations in Nigeria, Stakeholder Theory is highly relevant. Oil and gas activities significantly affect local communities, ecosystems, and regulatory bodies. Environmental impact analysis enables international firms to identify and manage the environmental concerns of key stakeholders. By addressing issues such as pollution, land degradation, and community health, firms strengthen trust and cooperation with host communities. This supports sustainable operational strategies by reducing conflicts, regulatory sanctions, and operational disruptions. Therefore, Stakeholder Theory provides a strong theoretical basis for linking environmental responsibility with sustainable operations of international oil and gas firms in Nigeria.

Sustainable development theory was formally articulated in 1987 by the World Commission on Environment and Development (WCED) through the Brundtland Report titled "Our Common Future." The theory assumes that economic growth, environmental protection, and social wellbeing are interdependent and must be pursued simultaneously. It emphasizes meeting present development and operational needs without compromising the ability of future generations to meet their own needs. The theory further assumes that natural resources are finite and must be managed responsibly. It advocates long-term planning, environmental conservation, and social responsibility in organisational operations (Eli *et al*., 2025; Arausi *et al*., 2025; Ukhurebor *et al*., 2021) [5, 7, 27]. The is highly relevant to this study as oil and gas activities often pose significant environmental risks such as oil spills, gas flaring, and ecosystem degradation. Environmental impact analysis helps international firms identify, assess, and mitigate these impacts. By integrating environmental considerations into operational strategies, firms can balance profitability with environmental protection and social welfare. This supports sustainable operational strategies that ensure long-term viability, regulatory compliance, and societal acceptance of oil and gas operations in Nigeria.

History of Oil and Gas Exploration in Nigeria

The history of oil and gas operations in Nigeria dates back to the early twentieth century and has played a central role in shaping the country's economic, political, and social development. Initial exploration activities began in 1908 when the Nigerian Bitumen Corporation conducted preliminary surveys in the present-day Ondo State. However, commercial exploration efforts intensified in the 1930s with the entry of Shell D'Arcy, now Shell Petroleum Development Company, which was granted exploration rights across large areas of Nigeria (Emuedo & Emuedo, 2019; Steyn, 2009; Iyeke & Bello, 2019) [9, 15, 26]. These early efforts were interrupted by the Second World War, but exploration resumed in the late 1940s. In 1956, Shell D'Arcy made the first commercial oil discovery in Oloibiri, located in present-day Bayelsa State, marking a turning point in Nigeria's petroleum history. By 1958, Nigeria recorded its first crude oil export, producing about 5,100 barrels per day, which laid the foundation for the country's emergence as a major oil-producing nation.

Following independence in 1960, the oil and gas sector expanded rapidly as multinational oil companies such as Mobil, Chevron, Agip, and Total joined Shell in exploration and production activities. During the 1960s and 1970s, oil production increased significantly, and petroleum gradually replaced agriculture as Nigeria's primary source of foreign exchange earnings. The oil boom of the 1970s further accelerated government revenue, infrastructure development, and urbanization, while also deepening the country's dependence on crude oil exports (Sakib, 2021; Emuedo & Emuedo, 2019) [9, 24]. In 1971, Nigeria joined the Organization of Petroleum Exporting Countries (OPEC), strengthening its position in the global oil market. The Nigerian government also increased its participation in the oil industry through the establishment of the Nigerian National Oil Corporation in 1971, which later merged with the Ministry of Petroleum Resources to form the Nigerian National Petroleum Corporation (NNPC) in 1977. This marked a shift toward greater state control and participation in upstream and downstream petroleum activities.

Throughout the 1980s and 1990s, Nigeria continued to expand its oil production capacity, while also developing its natural gas resources. However, this period was characterized by fluctuating global oil prices, economic instability, and structural adjustment policies that affected public spending and investment in the sector (James *et al*., 2023; Kwaghe, 2015) [18, 19]. At the same time, environmental degradation in the Niger Delta intensified due to oil spills, gas flaring, and weak regulatory enforcement. Host communities increasingly expressed grievances over pollution, land degradation, and perceived marginalization, leading to protests, conflicts, and disruptions to oil production. These challenges drew international attention to environmental justice and corporate responsibility in Nigeria's oil-producing regions.

In the early 2000s, Nigeria embarked on reforms aimed at improving transparency, governance, and efficiency in the petroleum sector. Initiatives such as the Nigeria Extractive Industries Transparency Initiative (NEITI) were introduced to promote accountability in revenue management. Efforts were also made to expand domestic refining capacity and reduce dependence on imported petroleum products (Sakib, 2021; Imobighe, 2015; Ite *et al*., 2024; Bamishe & Adegbie, 2024) [6, 10, 14, 24]. The Petroleum Industry Act (PIA) of 2021 marked a major milestone by restructuring the governance framework of the oil and gas sector, commercializing NNPC into NNPC Limited, and introducing new fiscal and regulatory regimes. The Act also established host community development trusts to address long-standing community grievances and promote sustainable development in oil-producing areas.

In recent years, Nigeria's oil and gas industry has faced new challenges and opportunities driven by global energy transitions, climate change concerns, and declining investments in fossil fuels. International oil companies have begun divesting from onshore and shallow water assets, while indigenous companies are increasingly taking over these operations. At the same time, Nigeria is seeking to

harness its vast natural gas reserves as a transition fuel to support industrialization and reduce carbon emissions (Sakib, 2021; Arausi *et al*., 2025; Eli *et al*., 2025; Akande, 2025) [1, 5, 7, 24]. Finally, the history of oil and gas operations in Nigeria reflects a complex interplay of economic growth, environmental challenges, governance reforms, and evolving global energy dynamics, which continue to shape the future of the country's petroleum sector

Environmental Impact Analysis of Oil and Gas Operations in Nigeria

Environmental Impact Analysis (EIA) of oil and gas operations in Nigeria is a systematic process used to identify, predict, and evaluate the potential effects of petroleum activities on the physical environment, ecosystems, and human communities, particularly in the Niger Delta. It is anchored in Nigeria's EIA Act of 1992 and related petroleum regulations, which require environmental studies before, during, and after major oil and gas projects to guide decision-making and ensure development is compatible with environmental protection (Ite *et al*., 2013; Stech, 2012; Umeh, 2004) [13, 25, 28]. Conceptually, EIA focuses on how exploration, drilling, production, refining, pipelines, and associated activities generate impacts such as oil spills, gas flaring, air emissions, effluent discharges, soil contamination, habitat loss, and long-term ecosystem degradation (Ukhurebor *et al*., 2021; Isah, 2012; Ite *et al*., 2013) [12, 13, 27]. These impacts manifest in polluted water bodies, damaged mangroves and farmlands, biodiversity loss, and serious health risks for local populations, including respiratory problems, cancers, and food insecurity (Ukhurebor *et al*., 2021; Ite *et al*., 2013; Isah, 2012; Eli *et al*., 2025) [7, 12, 13, 27].

The EIA process in Nigeria typically involves project screening and scoping, baseline environmental studies, impact prediction and quantification, evaluation of alternatives, and formulation of mitigation measures and an Environmental Management Plan (EMP) (Stech, 2012; Umeh, 2004) [25, 28]. Environmental Impact Statements (EISs) document these analyses, but quality reviews show that nearly half are unsatisfactory, with weak impact prediction, cumulative impact analysis, and poor attention to decommissioning and long-term monitoring (Stech, 2012; Anifowose *et al*., 2016) [3, 4, 25].

Scholars highlight that many operators treat EIA as a permit-securing formality, constrained by limited baseline data, weak enforcement, fragmented institutions, and low transparency, which reduces its effectiveness in managing real-world impacts (Nwankwo *et al*., in Arausi *et al*., 2025; Eli *et al*., 2025) [5, 7]. Despite these shortcomings, EIA remains the core legal and technical instrument for integrating environmental considerations into Nigeria's oil and gas decision-making, and reforms such as stronger public participation, periodic EIS quality audits, better inter-agency coordination, and alignment with modern environmental management systems (e.g., ISO 14001) are proposed to make EIA a more effective tool for safeguarding ecosystems, public health, and sustainable development in oil-producing regions (Arausi *et al*., 2025) [5].

Sustainable Operational Strategies of International Firms

Sustainable operational strategies of international firms refer to long-term business approaches that integrate economic performance, environmental responsibility, and social accountability into daily operations. These strategies focus on achieving operational efficiency while minimizing negative environmental impacts and promoting social wellbeing. International firms adopt sustainable operations to reduce resource consumption, waste generation, and carbon emissions. Such strategies involve the use of clean technologies, efficient production processes, and responsible supply chain management (James *et al*., 2022; Oruwari *et al*., 2025) [17, 23]. They also emphasize compliance with environmental regulations and global sustainability standards. Sustainable operational strategies promote ethical labour practices and community engagement in host countries. They support risk management by reducing environmental and reputational risks. These strategies enhance brand reputation and stakeholder trust. They also improve cost efficiency through energy savings and waste reduction.

Sustainable operations encourage innovation and continuous improvement. International firms use sustainability reporting to track and communicate performance (James *et al*., 2023; Iyoha *et al*., 2025; Emmanuel *et al*., 2022) [8, 16, 18]. These strategies align business goals with global climate and development objectives. They enable firms to adapt to changing regulatory and market conditions. Sustainable operational strategies also support long-term profitability and competitive advantage. Drawing from the precedents, with emphasis on environmental impact analysis, the following are sustainable operational strategies for international oil and gas firms operating in Nigeria,

1. **Strengthening Environmental Impact Assessment (EIA) Quality and Enforcement:** International firms should adopt rigorous, science-based EIAs that go beyond regulatory compliance by improving impact prediction, baseline data collection, and post-project monitoring to ensure effective environmental mitigation.

2. **Adoption of Cleaner and Low-Emission Technologies:** Firms should invest in advanced technologies to reduce gas flaring, oil spill frequency, and emissions, thereby minimising ecological damage and aligning operations with global climate commitments.

3. **Integrated Environmental Management and Monitoring Systems:** Implementing continuous environmental monitoring systems using digital tools and real-time data can help firms detect pollution early, prevent large-scale environmental damage, and improve operational efficiency.

4. **Community-Centred Engagement and Participatory Decision-Making:** International companies should involve host communities in environmental impact analysis and decision-making processes to address local concerns, reduce conflict, and strengthen social licence to operate.

5. **Alignment with ESG and Sustainability Frameworks:** Embedding environmental impact analysis into broader ESG and corporate sustainability strategies enables firms to meet investor expectations, improve transparency, and enhance long-term financial and reputational performance.

6. **Strategic Investment in Environmental Remediation and Biodiversity Conservation:** Firms should allocate resources to clean-up activities, restoration of degraded land and mangrove ecosystems, and conservation initiatives to mitigate past environmental harm and support ecosystem recovery.

7. **Planned Decommissioning, Transition, and Exit Strategies:** Incorporating environmental considerations into decommissioning and divestment plans ensures responsible asset closure, minimises long-term ecological risks, and supports a just transition for affected communities.

Conclusion

Environmental impact analysis is essential for addressing the ecological and social challenges associated with oil and gas operations in Nigeria. It provides international firms with critical information for designing sustainable operational strategies that reduce environmental harm and improve regulatory compliance. Effective environmental assessments enhance stakeholder trust and minimise operational risks. They also support long-term business sustainability and competitiveness. Finally, integrating environmental impact analysis into operational planning is vital for responsible and sustainable oil and gas operations in Nigeria.

Recommendations

Based on the study, the following were recommended:

1. International oil and gas firms in Nigeria should adopt rigorous, science-based EIAs to improve impact prediction, baseline data quality, and post-project environmental monitoring.
2. International oil and gas firms in Nigeria should invest in cleaner and low-emission technologies to reduce gas flaring, oil spills, and harmful emissions.
3. International oil and gas firms in Nigeria should implement integrated environmental monitoring systems using digital tools for real-time pollution detection and control.
4. International oil and gas firms in Nigeria should strengthen community participation in environmental assessment and decision-making to improve trust and reduce operational conflicts.
5. International oil and gas firms in Nigeria should align operations with ESG and sustainability frameworks to enhance transparency, investor confidence, and long-term performance.
6. International oil and gas firms in Nigeria should increase investment in environmental remediation and biodiversity restoration to address ecosystem damage and promote environmental recovery.
7. International oil and gas firms in Nigeria should develop responsible decommissioning and transition plans to ensure safe asset closure and protect host communities and ecosystems.

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