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ENVIRONMENTAL DEGRADATION, LIVELIHOODS, AND HEALTH IMPACTS OF OIL EXTRACTION ON MARITIME RESOURCES IN BRASS LGA, NIGER DELTA, NIGERIA

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Abstract
Environmental degradation from oil extraction poses significant threats to coastal livelihoods in the Niger Delta, yet integrated assessments linking ecological impacts to household well-being remain limited. This study investigates the socio-ecological consequences of oil pollution in Brass Local Government Area, Bayelsa State, Nigeria. Specifically, it assesses patterns of oil-induced environmental degradation, examines impacts on fisheries and mangroves, and analyzes livelihood and health outcomes for coastal communities. Two hypotheses were tested: (1) oil extraction significantly affects maritime resources, and (2) repeated exposure to oil spills negatively affects livelihoods and health. Data were collected from 300 respondents using structured questionnaires and supplemented with secondary spill records. Analyses employed descriptive statistics and multiple linear regression. Results indicate that frequent oil spills, primarily from illegal bunkering and pipeline failures, degrade fisheries, mangroves, and water quality, leading to reduced fish catch, loss of income, health challenges, and displacement. The study recommends stricter monitoring of oil infrastructure, ecological restoration, livelihood support programs, and risk communication to enhance community resilience and sustainable resource management.
Keywords: Oil-induced Environmental Degradation; Coastal Livelihoods; Niger Delta; Fisheries and mangroves; Community resilience

1. Introduction

Coastal ecosystems in extractive regions are globally significant socio-ecological systems that provide essential services, including fisheries, shoreline protection, and nutrient regulation. In recent years, growing attention has been directed toward the cumulative degradation of these environments due to intensified oil and gas extraction, particularly in developing regions where regulatory capacity remains weak (Zabbey et a., 2021; Numbere et al., 2023; Joffa & Sibiri, 2025). Empirical studies demonstrate that extractive activities accelerate habitat loss, marine pollution, and biodiversity decline, with direct consequences for food security and livelihood sustainability (Armstrong McKay et al., 2022; Arneth et al., 2023; Arthington, 2023). These patterns have positioned coastal degradation in extractive landscapes as a major global sustainability and environmental justice concern (Eriegha & Sam, 2020; Chijioke, et al., 2025).

The Niger Delta in Nigeria exemplifies these global challenges. As Africa's largest oil-producing region, it has experienced decades of environmental stress associated with oil spills, gas flaring, pipeline vandalism, and poorly maintained infrastructure. Extensive scholarly work by Nigerian researchers has documented

the persistence of hydrocarbon contamination in surface water, sediments, and coastal ecosystems, often exceeding acceptable environmental thresholds (Abam & Fubara, 2022; Alao, 2024; Chijioke et al., 2025). Recent studies further indicate that environmental degradation remains widespread despite regulatory reforms, highlighting structural weaknesses in enforcement and remediation efforts (Diab et al., 2023; Erifeta et al., 2024). Maritime resources are central to livelihoods across the Niger Delta, particularly among coastal and riverine communities where artisanal fishing constitutes a primary economic activity. Fisheries and mangrove ecosystems provide food, income, and cultural identity, while also supporting broader coastal resilience. Nigerian scholars have consistently shown that oil pollution disrupts these systems by degrading spawning grounds, reducing fish abundance, and contaminating aquatic habitats (Ewim et al., 2023; Ikhumetse et al., 2022; Kalu, 2025). The resulting decline in maritime productivity has been linked to income loss, food insecurity, and increased livelihood vulnerability among fishing households, especially in Bayelsa and Rivers States (Aaron, 2011; Akpandem et al., 2025). Despite a substantial body of research on environmental pollution in the Niger Delta, important gaps remain (Adegoriola et al., 2024; Ansah et al., 2022; Ewim et al., 2023; Kalu, 2025). Much of the existing literature examines environmental contamination or socio-economic impacts in isolation, with limited empirical integration of ecosystem degradation and livelihood outcomes at local scales. Recent reviews emphasize the need for place-based studies that link oil-related environmental exposure with changes in maritime resource systems and household livelihoods using primary data (Zabbey et al., 2021; Victor et al., 2024). Such integrated analyses remain scarce in sub-regional coastal contexts, including Brass Local Government Area, where dependence on maritime resources is high and exposure to oil-related risks is pronounced.

This study addresses a critical gap in understanding the socio-ecological impacts of oil extraction in Brass Local Government Area, Bayelsa State. It examines patterns of oil-induced environmental degradation in coastal ecosystems, with particular emphasis on the ecological effects of oil pollution on maritime resources such as fisheries and mangrove systems. In addition, the study investigates how sustained exposure to oil-related environmental stressors influences livelihoods, health outcomes, and the broader socio-economic well-being of coastal communities. The study is guided by the hypothesis that oil extraction activities significantly degrade maritime resources, resulting in declining fisheries, mangrove degradation, and reduced biodiversity. It also hypothesizes that repeated exposure to oil spills and associated environmental degradation adversely affects household livelihoods, health, and socio-economic conditions within the study area.

1.1 **Conceptual and Literature Review**

Oil extraction in the Niger Delta has profoundly altered the region's coastal ecosystems, leading to severe environmental degradation with direct consequences for local livelihoods. Research shows that repeated oil spills, pipeline leaks, and gas flaring have disrupted soil, water, and air quality, resulting in a cascade of ecological consequences. Ansah et al. (2022) demonstrate through remote sensing and field measurements that oil-

contaminated soils exhibit significantly reduced fertility and altered physicochemical properties, which negatively affect vegetation growth and agricultural productivity. Similarly, studies by Ipogah & Ikenga (2023) highlight that aquatic ecosystems in oil-impacted areas suffer from reduced fish abundance and biodiversity loss due to petroleum hydrocarbon contamination, threatening the subsistence and economic security of fishing-dependent households. These environmental stressors are not isolated; they interact to create a long-term decline in ecosystem resilience, making recovery slow and complex. This degradation is compounded by poor enforcement of environmental regulations, which allows spills and flaring to continue unabated (Ekpenyong &Udofia 2022).

Gas flaring, a prominent feature of oil extraction in Nigeria, exacerbates environmental stress through atmospheric pollution, heat emissions, and acid rain formation. Studies have reported elevated concentrations of particulate matter, sulfur dioxide, and nitrogen oxides in communities close to flare sites, correlating with respiratory illnesses and declining crop yields (Okoroafor & Ezeoha (2025). Adegoriola et al., 2024). In addition, the constant heat from flaring contributes to soil moisture loss, affecting both crop productivity and natural vegetation cover. These environmental stressors collectively undermine the natural resource base on which rural communities depend, reinforcing cycles of vulnerability and poverty. While regulatory approaches exist to mitigate these impacts, enforcement is often weak, and local communities remain disproportionately exposed to environmental hazards.

The degradation of natural resources translates directly into livelihood challenges for households in the Niger Delta. Agriculture and fishing, historically the backbone of local livelihoods, are severely affected by soil contamination and reduced aquatic productivity (Siloko, 2024). Empirical studies indicate that affected households experience declines in both food availability and income, forcing them to diversify into risky or non-traditional livelihood strategies, such as informal labor or migration to urban centers (Ezuma & Sunday, 2021). Socio-economic analyses further reveal that environmental degradation exacerbates poverty and inequality, particularly for households with limited assets or adaptive capacity. Livelihood vulnerability is compounded by the seasonal nature of environmental shocks and limited access to institutional support, which together create entrenched cycles of vulnerability and resource dependence (Kunjuraman, 2022; Mbiba, 2022; Numbere et al., 2023). To analyze these dynamics, integrating the Sustainable Livelihoods concept (SLC) with Environmental Impact Assessment (EIA) provides a comprehensive understanding of environmental and socio-economic interactions. EIA enables the systematic assessment of environmental risks posed by oil extraction, including impacts on soil, water, and air quality, while SLF emphasizes how these environmental changes affect household assets and coping strategies (Eriegh & Sam, 2020; Zabbey et al., 2021.). By combining these approaches, scholars can trace the pathways through which environmental degradation translates into livelihood disruption, offering insight into vulnerability and resilience patterns in affected communities. For example, Kabiri et al. (2024) applied an

integrated approach to examine oil-impacted communities in Ogoniland, showing how contamination of water and soil assets directly constrained livelihood strategies and household well-being. The social dimensions of environmental degradation are equally significant. Beyond material impacts, oil-related environmental stressors affect social structures, health, and community cohesion. Communities facing repeated spills often experience displacement, loss of cultural heritage linked to fishing and farming, and increased conflict over dwindling resources (Joffa & Sibiri, 2025). Health consequences, including exposure to toxic chemicals, air pollution, and water-borne diseases, further exacerbate socio-economic vulnerability (Sibiri et al., 2022). Collectively, these studies indicate that oil extraction generates multidimensional impacts that extend beyond environmental degradation, encompassing socio-economic, cultural, and health domains.

Although existing studies have extensively documented the environmental consequences of oil extraction and their socio-economic implications in the Niger Delta, the evidence remains fragmented and unevenly contextualized. Many studies focus either on biophysical environmental degradation or on livelihood and health outcomes, without systematically linking patterns of oil-induced environmental change to specific impacts on maritime resources such as fisheries and mangrove ecosystems. Furthermore, empirical analyses that integrate ecological degradation with household-level livelihood and health outcomes remain limited, particularly within coastal local government areas like Brass in Bayelsa State. As a result, there is insufficient understanding of how oil-related environmental stressors simultaneously shape ecosystem integrity, resource-dependent livelihoods, and community health within a single analytical approach. This study addresses these gaps by assessing patterns of oil-induced environmental degradation, examining their ecological effects on maritime resources, and analyzing the resulting livelihood and health outcomes for coastal households.

2. Study Area

Brass Local Government Area (LGA) is located in the southern part of Bayelsa State (Figure1), within the Niger Delta region of Nigeria. It is a coastal area of significant ecological and socio-economic importance. Brass is situated on Brass Island in the Nun River estuary, between approximately 4°30' N latitude and 5°30' E longitude. The LGA covers an area of 1,404 square kilometers and has a coastline of about 90 kilometers along the Bight of Bonny. The region is part of the world's third-largest wetland. It features diverse ecosystems, including mangrove forests, freshwater swamps, and lowland rainforests. These habitats support a rich variety of flora and fauna. The climate is tropical monsoon, with high temperatures and humidity throughout the year. The wet season, from April to October, sustains the area's dense vegetation and intricate network of waterways.

Historically, Brass was a traditional fishing village of the Nembe branch of the Ijaw people. It later became a trading port for palm oil and other commodities. Fishing and small-scale trade remain central to the local economy. These activities highlight the community's strong dependence on maritime and coastal resources. They are vital for livelihoods and

help shape the social and cultural identity of the population. Brass LGA is also home to several oil and gas installations. These facilities provide economic opportunities but have introduced environmental challenges. Oil spills and gas flaring have negatively affected both the ecosystem and local communities. The combination of ecological richness, dependence on maritime resources, and exposure to oil and gas activities makes Brass LGA an ideal case study. It illustrates the complex interactions between coastal ecosystems, resource-based livelihoods, and environmental vulnerability in the Niger Delta.

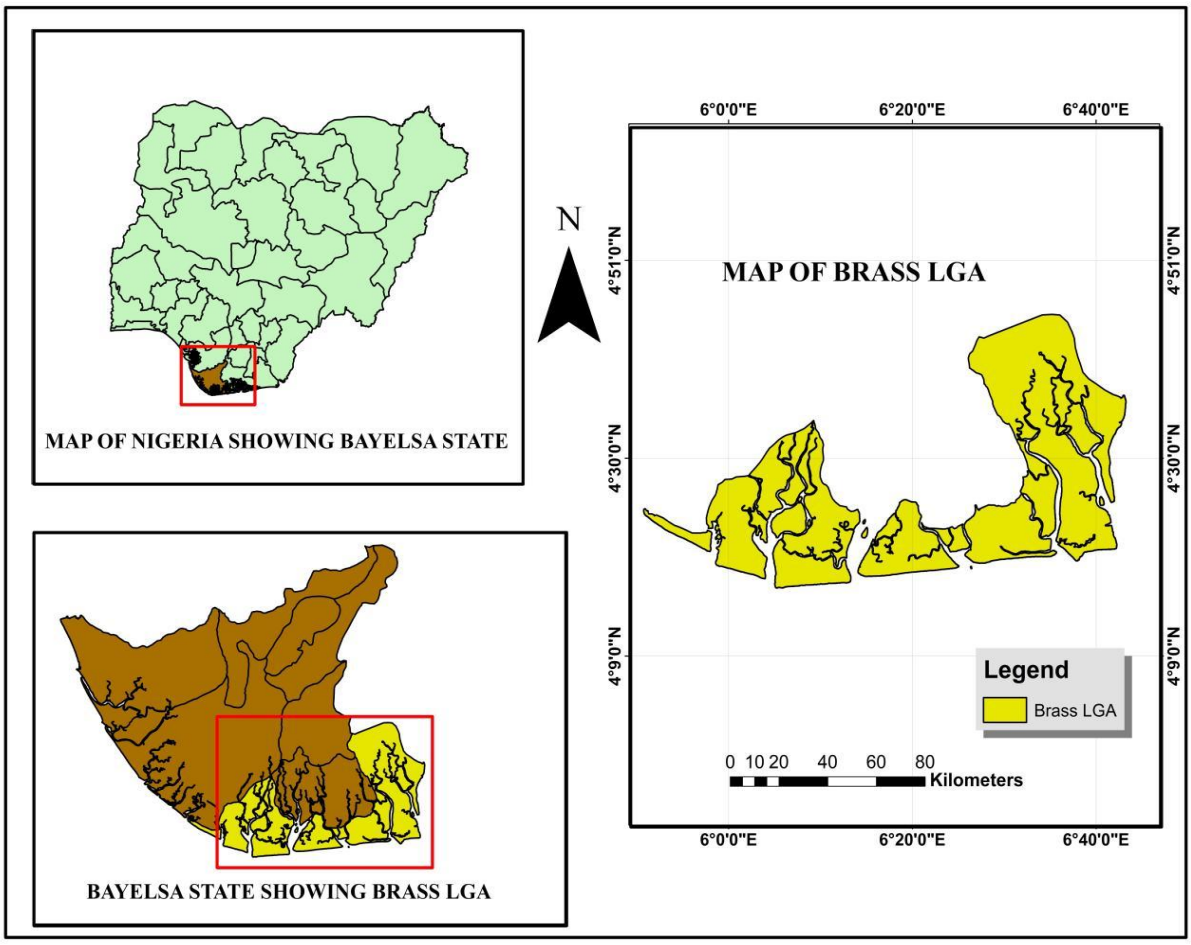

Figure 1. Brass Local Government Area, Bayelsa State, Nigeria.
Source: Author's Map Production

3. Materials and Methods

This study examines the environmental and livelihood impacts of oil extraction in Brass Local Government Area (LGA), Bayelsa State. It focuses on patterns of oil-induced environmental degradation, impacts on fisheries and mangroves, and the resulting livelihood outcomes for coastal communities. The study assumes that oil spills, gas flaring, and oil infrastructure drive ecological change and socio-economic vulnerability, with poorer households being most at risk. Governance and institutional capacity are treated as factors influencing both environmental impacts and the effectiveness of mitigation strategies.

Primary data were collected using a structured questionnaire administered to adults aged 18 years and above across fourteen localities in Brass LGA. A modified systematic random sampling approach was adopted to

ensure spatial representation across the dispersed coastal localities of Brass LGA while minimizing selection bias. Given the linear and fragmented settlement pattern characteristic of riverine and coastal communities in the study area, systematic sampling allowed for an even distribution of sampled localities across the LGA, reducing the risk of over-representing communities with higher accessibility or population density. The use of a randomized starting point further enhanced randomness and improved the representativeness of the sample. This approach was considered appropriate for capturing variations in exposure to oil extraction activities and associated environmental and livelihood impacts across different localities. Sample size was determined using Taro Yamane's formula:

$$n = \frac{N}{1 + N(e)^2}$$

where n= sample size, N= population, and e= level of precision.

The sample size of 300 respondents was determined using Taro Yamane's formula to achieve an adequate balance between statistical reliability and field feasibility in a geographically challenging environment. The formula is widely applied in social and environmental research to generate a representative sample at a defined level of precision, ensuring that the selected sample sufficiently reflects the study population while accounting for resource and logistical constraints.

The questionnaire had four sections: (i) demographic and socio-economic characteristics, (ii) awareness and perceptions of environmental issues such as oil spills and ecosystem degradation, (iii) effects of oil extraction on livelihoods and food security including fishing yields, access to clean water, and health outcomes, and (iv) government and community responses, including participation in ecosystem restoration and mitigation programs.

Secondary data included oil spill records from the Department of Petroleum Resources and NOSDRA.

Data analysis combined descriptive and inferential statistics. Descriptive analyses summarized demographic, environmental, and livelihood characteristics as percentages. Multiple linear regression was applied to test Hypothesis 1 (Objective 1: impacts of oil extraction on maritime resources) and Hypothesis 2 (Objective 3: livelihood and health outcomes of oil pollution). The regression model followed the general formula:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \epsilon_i$$

where Y_i = dependent variable (maritime resource condition or livelihood outcome), $X_1, X_2, \ldots, X_k$ = independent variables (frequency of oil spill exposure, awareness of spills, and other predictors), β_0= intercept, β_k= regression coefficients, and ϵ_i = error term. Hypotheses were tested at $p < 0.05$.

Ethical considerations included obtaining informed consent, anonymizing responses, secure data storage, and institutional review board approval. Participants were informed of their right to withdraw, and support resources were made available to address potential distress.

4. Result and Discussion

4.1 Demographic and Socio-Economic Information

The demographic composition of respondents provides an important contextual basis for interpreting the study findings. The predominance of working-age adults (31–50 years) reflects the segment of the population most actively engaged in fishing, farming, and other coastal livelihood activities, making them particularly vulnerable to oil-induced environmental degradation. Similar age structures have been reported in coastal Niger

Delta studies, where economically active adults bear the greatest livelihood risks associated with environmental shocks (Siloko, 2024; Numbere et al., 2023). The slightly higher female representation aligns with evidence that women play a central role in post-harvest fisheries activities, household food security, and water collection, thereby experiencing oil pollution impacts both directly and indirectly (Mbiba, 2022). The high proportion of divorced respondents may reflect socio-economic stress and displacement linked to environmental instability, as reported in other oil-impacted communities (Ezuma & Sunday, 2021). These characteristics underscore the socio-economic sensitivity of the study population and reinforce the relevance of examining livelihood and health outcomes alongside environmental change. Table 1 presents the demographic and socio-economic characteristics, while Figure 2 illustrates the spatial distribution of respondents across Brass LGA.

Table 1: 1**Demographic and Socio-Economic Information of Respondents**

Category	**Subcategory**	**Percent (%)**
Gender	Male	45.0
	Female	55.0
Age Group	18–30	20.0
	31–40	40.0
	41–50	40.0
Marital Status	Married	25.0
	Divorced	50.0
	Single	25.0
Total	—	100.0

Author's field work (2025)

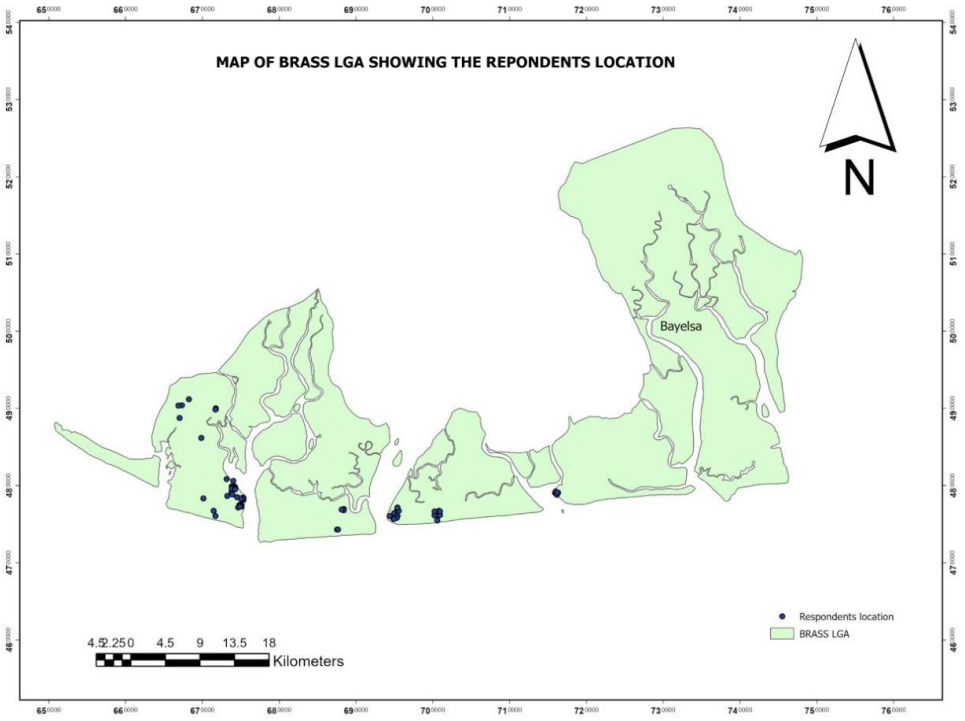

Figure 2: Geographic Distribution of Respondents by Locality within the Study Area
Author's field work (2025)

4.2 Assessment of Oil-induced Environmental Degradation Patterns in Brass Local Government Area

The study assessed the patterns of oil-induced environmental degradation in Brass Local Government Area (LGA) by examining awareness, frequency, sources, and community exposure to oil spills. The results, summarized in Figure 2, highlight both the extent and the nature of environmental pressures linked to oil extraction activities.

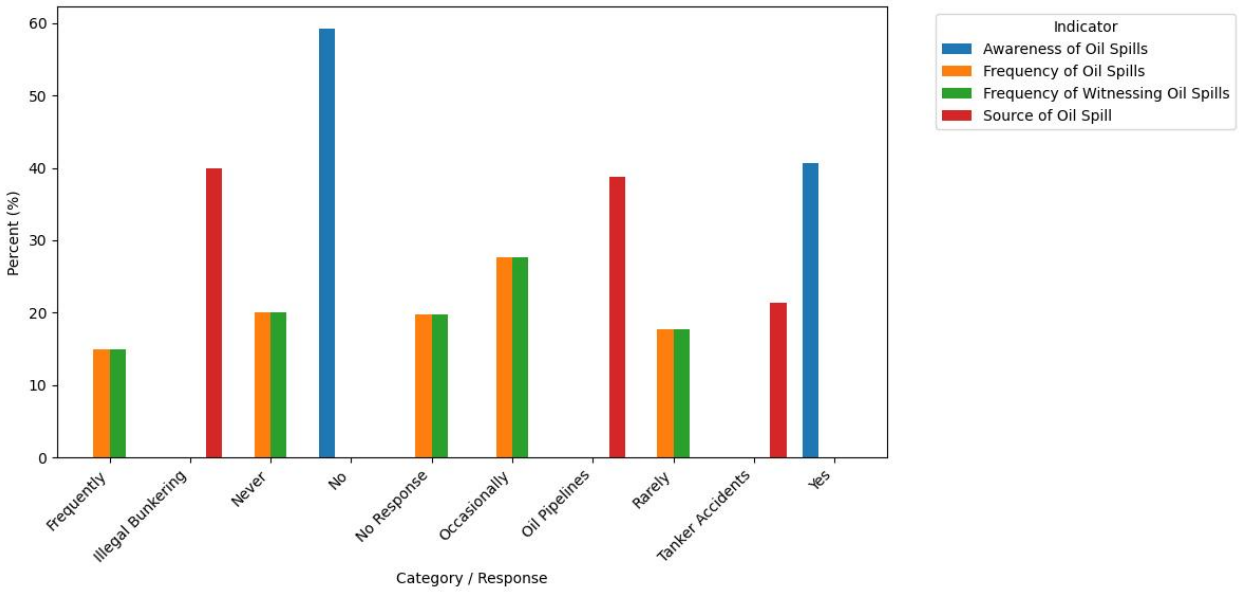

Figure 2: Indicators of Oil – Induced Environmental Degradation in Brass LGA
Author's field work (2025)

Analysis of respondents' awareness shows that only 40.7% reported being aware of oil spills in their community, while 59.3% were not. This low level of awareness highlights a critical gap in environmental communication and raises concerns that oil pollution may be underreported or that residents may lack the knowledge to detect early signs of environmental degradation, such as water discoloration or reduced fish availability. Regarding the frequency of oil spills, 15.0% of respondents reported frequent occurrences, 27.7% occasional spills, 17.7% rare incidents, 20.0% never experiencing spills, and 19.7% did not respond. This pattern indicates that oil spills are spatially and temporally uneven, reflecting the interplay of oil infrastructure, illegal bunkering, and possible underreporting. The fact that a substantial portion of the population experiences spills frequently or occasionally suggests that Brass LGA is subject to recurrent environmental stress, with potential cumulative impacts on fisheries and mangroves.

The observed patterns of oil-induced environmental degradation in Brass LGA reveal both structural and behavioral drivers of ecosystem stress. The relatively low level of reported awareness of oil spills contrasts with the documented frequency of spill events, suggesting gaps in environmental communication, reporting mechanisms, and community capacity to detect or interpret ecological change. Similar findings have been reported by Ekpenyong and Udofia (2022), who argue that limited environmental literacy and weak institutional feedback systems contribute to the underreporting of oil pollution in Niger Delta communities.

The sources of oil pollution were dominated by illegal bunkering (40.0%) and oil pipeline failures (38.7%), with tanker accidents contributing 21.3%. This distribution illustrates the dual nature of oil-induced degradation in Brass: stemming from both systemic infrastructure vulnerabilities and illegal human activities. Illegal bunkering, in particular, introduces unpredictability into patterns of degradation, complicating monitoring and mitigation efforts.

Personal exposure to oil spills mirrors these trends, with 15.0% frequently exposed, 27.7% occasionally exposed, 17.7% rarely exposed, 20.0% never exposed, and 19.7% not responding. The variation in exposure suggests that proximity to oil infrastructure, community awareness, and engagement with local environmental issues influence residents' experiences. Consequently, some areas may face acute ecological stress while others are less affected, creating spatial heterogeneity in environmental degradation.

The uneven frequency and exposure to oil spills observed in this study reflect the spatial heterogeneity of oil infrastructure and illegal activities such as bunkering. This aligns with previous research indicating that spill occurrence in the Niger Delta is highly localized, driven by pipeline density, security conditions, and enforcement capacity (Ukhurebor et al., 2023). The dominance of illegal bunkering and pipeline failures as pollution sources reinforces the argument that environmental degradation in the region is not solely an operational issue but also a governance and security challenge. These findings support broader literature emphasizing that weak regulation and illicit activities jointly exacerbate environmental degradation in oil-producing regions (Ansah et al., 2022; Zabbey et al., 2021).

Table 2: Hypothesis 1 – Impact of Oil Extraction on Maritime Resources

Predictor Variable	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (Beta)	t-value	p-value
Constant	1.690	0.077	–	21.890	0.000
Frequency of witnessing/hearing oil spills	-0.034	0.013	-0.202	-2.565	0.011
Awareness of oil spills	0.009	0.037	0.019	0.243	0.808

Model Summary**:** $R = 0.206$, $R^2 = 0.042$, Adjusted $R^2 = 0.030$, $F(2,157) = 3.464$, $p = 0.034$

Author's field work (2025)

The multiple linear regression analysis examining the impact of oil spill awareness and frequency on maritime resources in Brass LGA is presented in Table 2. The model was statistically significant ($F = 3.464$, $p = 0.034$), indicating that the predictors explain a meaningful portion of the variation in maritime resource conditions. The frequency of witnessing or hearing about oil spills had a significant negative effect on maritime resources ($\beta = -0.202$, $p = 0.011$), suggesting that communities exposed to more frequent spill events experience greater degradation of fisheries, mangroves, and biodiversity. In contrast, general awareness of oil spills was not statistically significant ($p = 0.808$), indicating that knowledge alone does not necessarily correspond to observable ecological changes. These findings support Hypothesis 1, which proposed that oil extraction activities significantly affect maritime resources in the Niger Delta. The results highlight spill frequency as a critical driver of environmental degradation, with repeated events, particularly from illegal bunkering and pipeline failures thereby posing significant threats to coastal ecosystems. The analysis also underscores the need for effective monitoring of oil infrastructure and targeted community-level interventions to mitigate environmental impacts and promote sustainable management of fisheries, mangroves, and biodiversity in Brass LGA.

The regression results provide empirical support for the hypothesis that oil extraction

activities significantly degrade maritime resources. The significant negative effect of spill frequency on maritime resource condition is consistent with studies documenting cumulative ecological damage from repeated oil exposure, including reduced fish stocks, mangrove dieback, and biodiversity loss (Ipogah & Ikenga, 2023; O'Farrell, 2025). The non-significant effect of spill awareness suggests that ecological degradation is driven more by physical exposure than by perception or knowledge, reinforcing the notion that awareness alone cannot mitigate biophysical impacts without effective remediation and enforcement. This finding aligns with environmental impact studies in Ogoniland and coastal Bayelsa State, which show that even communities with high awareness continue to experience ecosystem decline due to persistent exposure and limited institutional response (Kabiri et al., 2024). The relatively low explanatory power of the model further suggests that maritime resource degradation is influenced by additional unmeasured factors such as spill volume, cleanup delays, hydrodynamic conditions, and seasonal variability, which have been highlighted in previous studies as critical drivers of ecological outcomes.

4.3 Assessment of the Impacts of Oil Pollution on Fisheries and Mangrove Ecosystems in Brass LGA

The analysis of respondents' perceptions indicates that oil pollution has substantial impacts on both the ecological and socio-economic dimensions of maritime ecosystems in Brass LGA. As shown in Table 2, 56.3% of respondents reported that fishing activities in their communities have been affected by oil pollution. Nearly half of the respondents noted changes in the type of fish caught (45.6%) and in the quality or quantity of fish (48.1%), while 57.5% observed alterations in the colour or smell of water. These findings demonstrate that oil spills and related environmental degradation are significantly disrupting local fisheries and mangrove ecosystems, with observable impacts on water quality and biodiversity.

Table 2: Impacts of Oil Pollution on Fisheries and Mangrove Ecosystems in Brass LGA

Impact Indicator	Percentage (%)
Oil pollution has affected fishing activities	56.3
Noticed changes in type of fish caught	45.6
Changes in fish quality or quantity	48.1
Observed changes in water colour or smell	57.5

Author's field work (2025)

From a livelihood perspective, the effects of these ecological disturbances are pronounced. Table 3 shows that fishing activities have been impacted through reduced fish catch (32.5%), loss of fishing grounds (33.1%), and damage to fishing equipment (34.4%). This indicates that oil pollution is not only altering ecological conditions but also directly affecting income-generating activities that sustain the local communities. The overlap between ecological degradation and livelihood impacts highlights the close interdependence of environmental health and socio-economic well-being in coastal areas.

Table 3: Livelihood Impacts of Oil Pollution on Fishing Activities in Brass LGA

Impact on Fishing Activities	Percentage (%)
Reduced fish catch	32.5
Loss of fishing grounds	33.1
Damage to fishing equipment	34.4

Author's field work (2025)

The observed patterns can be linked to both systemic and anthropogenic factors. Illegal bunkering (40%) and pipeline failures (38.7%) were identified as the primary sources of oil pollution, with tanker accidents contributing 21.3%, reflecting both operational vulnerabilities and illicit activities. These high-risk sources create recurrent, spatially heterogeneous environmental stress that disproportionately affects fisheries and mangrove habitats. The cumulative impact of repeated oil spills compromises breeding grounds, reduces fish diversity, and degrades mangrove vegetation, consistent with findings from other studies in the Niger Delta (e.g., O'Farrell, 2025; Ukhurebor et al., 2023). Figure 3, combined clustered bar chart showing both ecological and livelihood impacts of oil pollution in Brass LGA. It clearly separates ecosystem-level impacts (like changes in fisheries and water quality) from community livelihood impacts (like reduced catch, loss of fishing grounds, and damaged equipment), while allowing easy comparison.

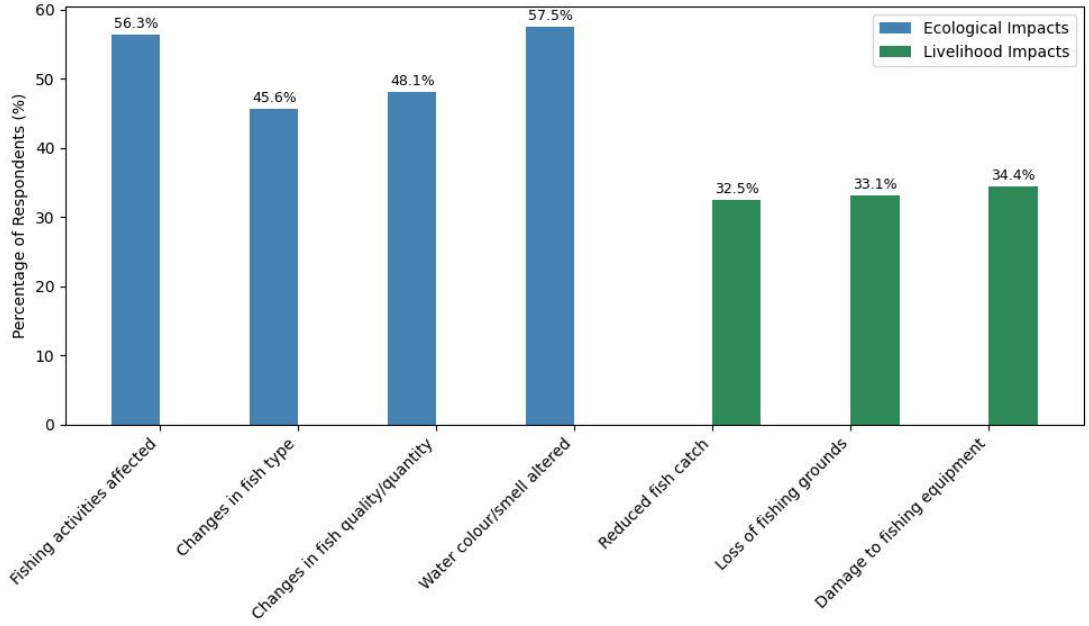

Figure 3: Ecological vs Livelihood Impacts of Oil Pollution in Brass LGA
Author's field work (2025)

Critically, the data reveal that ecological disruption translates directly into socio-economic consequences. Reduced fish catches, loss of fishing grounds, and damaged equipment impair livelihoods, exacerbate poverty, and increase food insecurity, particularly in communities that depend primarily on artisanal fisheries. This reinforces the conceptual link between environmental degradation and human vulnerability, demonstrating that oil-induced ecological changes have cascading effects on community well-being. The results provide clear evidence that oil pollution in Brass LGA is a major driver of maritime ecosystem degradation and livelihood disruption. The findings highlight the need for integrated interventions that address both ecological restoration and community resilience, including enhanced monitoring of oil infrastructure, stricter regulation of illegal bunkering, and targeted support for affected fishing communities. These measures are essential for safeguarding both the environmental and socio-economic sustainability of coastal ecosystems in the Niger Delta.

The reported impacts on fisheries and mangrove ecosystems reflect a clear linkage between ecological degradation and livelihood disruption. Observed changes in fish type, quantity, and water quality are consistent with hydrocarbon contamination effects documented across the Niger Delta, where oil alters aquatic habitats, disrupts breeding cycles, and reduces species diversity (Ukhurebor et al., 2023). Mangrove degradation, though not directly quantified, is implied through reported changes in water quality and fishing grounds, corroborating studies that identify mangroves as highly sensitive to oil pollution due to their sediment-trapping capacity (Numbere et al., 2023). From a livelihood perspective, reduced fish catch, loss of fishing grounds, and equipment damage mirror findings from other artisanal fishing communities where environmental degradation directly undermines income security and food availability (Siloko, 2024). These results reinforce the Sustainable Livelihoods Framework assumption that natural capital degradation has immediate and

4.4 Assessment of Livelihood Impacts of Oil-Driven Environmental Degradation on Coastal Communities

The analysis of livelihood outcomes demonstrates that oil pollution and extraction activities in Brass LGA have profound socio-economic consequences for coastal communities. As summarized in Table 4, respondents reported experiencing health problems (38.1%), damage to fishing equipment (34.4%), loss of fishing grounds (33.1%), reduced fish catch (32.5%), displacement from homes (31.3%), and loss of income (30.6%). These findings indicate that the effects of oil-induced environmental degradation extend well beyond ecological impacts, directly undermining the economic stability, health, and living conditions of local residents.

Table 4: Livelihood Outcomes of Oil Pollution for Coastal Communities in Brass LGA

Livelihood Outcome	Percentage (%)
Loss of income	30.6
Health problems	38.1
Displacement from home	31.3
Reduced fish catch	32.5
Loss of fishing grounds	33.1
Damage to fishing equipment	34.4

Author's field work (2025)

The multiple linear regression analysis (Table 5, Hypothesis 2) corroborates these patterns. The model was statistically significant ($F = 9.868$, $p < 0.001$), explaining 11.2% of the variance in health and livelihood outcomes. The frequency of witnessing or hearing about oil spills was positively associated with livelihood disruptions ($\beta = 0.169$, $p = 0.027$), suggesting that recurrent exposure to spill events exacerbates socio-economic stress. In contrast, general awareness of oil spills was negatively associated with livelihood outcomes ($\beta = -0.266$, $p = 0.001$), reflecting that knowledge of environmental hazards may amplify psychological and social burdens in addition to tangible economic effects. These results highlight the complex interplay between environmental exposure, perception, and community vulnerability.

Table 5: Hypothesis 2 – Oil Pollution and Health & Livelihood Outcomes

Predictor Variable	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (Beta)	t-value	p-value
Constant	1.722	0.086	–	20.035	0.000
Frequency of witnessing/hearing oil spills	0.033	0.015	0.169	2.232	0.027
Awareness of oil spills	-0.143	0.041	-0.266	-3.508	0.001

Model Summary**:** $R = 0.334$, $R^2 = 0.112$, Adjusted $R^2 = 0.100$, $F(2,157) = 9.868$, $p < 0.001$
Author's field work (2025)

Critically, these outcomes reflect both direct and indirect pathways through which oil pollution compromises livelihoods. Reduced fish catch, loss of fishing grounds, and damaged equipment directly diminish income and food security, while health problems

arising from consumption of contaminated seafood increase healthcare costs and reduce labor capacity. Displacement from homes, reported by over 30% of respondents, suggests that environmental degradation also drives social instability and forced migration in coastal areas.

The regression analysis for Hypothesis 2 confirms that recurrent exposure to oil spills significantly exacerbates livelihood and health challenges. The positive association between spill frequency and adverse livelihood outcomes supports earlier findings that repeated environmental shocks intensify poverty, displacement, and health vulnerability (Sibiri et al., 2022). Health problems reported by respondents likely stem from multiple exposure pathways, including contaminated water, polluted air, and consumption of affected seafood, as documented in prior studies across oil-producing coastal regions. The negative relationship between awareness and livelihood outcomes is particularly noteworthy. While awareness is often assumed to enhance resilience, this finding suggests that knowledge of environmental hazards may increase psychological stress, risk perception, and feelings of powerlessness in contexts where institutional support is weak. Similar observations have been made by Joffa and Sibiri (2025), who argue that awareness without actionable mitigation can heighten vulnerability rather than reduce it. This underscores the importance of coupling environmental education with tangible support mechanisms and institutional responsiveness.

5. Conclusions

This study demonstrates that oil extraction activities in Brass Local Government Area, Bayelsa State, have profound and multidimensional impacts on both coastal ecosystems and the livelihoods of dependent communities. The findings show that frequent oil spills, largely resulting from illegal bunkering and pipeline failures, have significantly degraded fisheries, mangrove forests, and water quality. These ecological disturbances directly translate into socio-economic consequences, including reduced fish catch, loss of fishing grounds, damaged equipment, income loss, displacement, and health challenges. The study confirms that environmental degradation in oil-producing coastal regions is not merely an ecological problem but a socio-ecological crisis, threatening the sustainability, resilience, and well-being of communities that rely heavily on maritime resources. Importantly, the results indicate that awareness alone is insufficient to mitigate impacts, highlighting the need for integrated strategies that simultaneously address ecological restoration and community resilience.

Conceptually, this research advances the literature on oil-induced environmental degradation and coastal livelihoods by providing an integrated socio-ecological analysis. Unlike previous studies that often examine environmental pollution or livelihood outcomes in isolation, this study links ecological degradation directly to household-level socio-economic impacts, illustrating the cascading effects of oil-related environmental shocks. By focusing on Brass LGA, the research contributes localized, place-based evidence to a region that is often underrepresented in Niger Delta scholarship. Furthermore, the study employs regression and spatial analyses to quantify the relationships between oil spill frequency, ecosystem health,

and livelihood outcomes, providing empirical validation of theoretical frameworks such as the Sustainable Livelihoods Approach and Environmental Impact Assessment. These findings underscore the interdependence of ecosystem services and human well-being, highlighting how environmental degradation undermines livelihood security in coastal communities.

From a policy perspective, the study offers actionable insights for managing oil-induced environmental challenges and strengthening community resilience. By identifying both systemic drivers, such as pipeline failures, and anthropogenic drivers, such as illegal bunkering, the research emphasizes the need for stricter regulatory enforcement, enhanced monitoring of oil infrastructure, and targeted remediation of degraded ecosystems. Policy interventions should also prioritize socio-economic support for affected households, including livelihood diversification, financial assistance, health services, and risk communication programs. The evidence that awareness may amplify perceived vulnerability further points to the importance of psychosocial support and participatory governance in environmental management. Integrating ecological restoration with livelihood support and robust institutional frameworks is therefore essential for achieving sustainable resource management in oil-producing coastal regions.

Looking ahead, future research should build on these findings to better understand the temporal, spatial, and social dimensions of oil-induced degradation. Longitudinal studies would provide insight into the cumulative impacts of oil extraction and the resilience trajectories of affected ecosystems and communities. Detailed health assessments could illuminate the public health risks associated with contaminated water and seafood consumption. Economic valuation of lost ecosystem services could strengthen the rationale for remediation and policy interventions. Comparative studies across multiple coastal LGAs would reveal spatial patterns of vulnerability, while participatory and governance-focused research could identify effective community engagement strategies and accountability mechanisms. By addressing these gaps, future studies can enhance our understanding of socio-ecological vulnerability and inform more effective policies for sustainable development and environmental justice in the Niger Delta and similar coastal regions worldwide.

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