

Environmental Regulations, Oil Spillage Management Strategies and Residents' Perception of Water Quality in Ohaji/Egbema Local Government Area of Imo State, Nigeria

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Abstract

This study examined the influence of environmental regulations and oil spill prevention measures on residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State, Nigeria. A descriptive survey research design was adopted for the study. The population comprised 254,200 residents of Ohaji/Egbema Local Government Area. Using Cochran's sample size determination formula, a sample of 422 respondents was selected through a multi-stage sampling procedure. Data were collected using a structured

questionnaire validated by three experts in Environmental Education, and Measurement and Evaluation. The reliability of the instrument was established before the main study. Data were analyzed using Pearson Product Moment Correlation (PPMC) at 0.05 level of significance. The findings revealed that environmental regulations, and oil spill prevention measures had significant positive relationships with residents' perception of water quality ($r = .473, p < .05$). The study concluded that effective environmental regulations and oil spill prevention measures significantly enhance residents' perception of water quality in Ohaji/Egbema Local Government Area. It recommended strengthening the enforcement of environmental regulations and improving oil spill prevention measures to enhance water quality management.

Keywords: environmental regulations, oil spill prevention measures, residents' perception, water quality, oil spillage management

Introduction

Petroleum exploration and production remain central to Nigeria's economy, contributing substantially to national revenue and foreign exchange earnings. However, the environmental costs associated with oil exploration have become increasingly evident, particularly in the Niger Delta region where repeated oil spill incidents have degraded ecosystems, polluted water resources, threatened biodiversity, and undermined the livelihoods of host communities. Oil spills introduce petroleum hydrocarbons and other hazardous substances into surface water and groundwater, reducing water suitability for domestic, agricultural, and economic uses. Although technological advancements have improved oil production processes, the frequency of oil spill incidents and the effectiveness of management interventions continue to generate environmental and public health concerns across many oil-producing communities in Nigeria (Ebisi, 2025; Olowoyo et al., 2026).

The increasing occurrence of oil spill incidents has shifted attention from merely assessing the environmental impacts of oil pollution to evaluating the effectiveness of oil spillage management strategies. Oil spillage management strategies refer to the coordinated legal, technical, institutional, and community-based measures implemented to prevent oil spills, minimize their impacts, and protect affected environments. Within this broad framework, environmental regulations and oil spill prevention measures are particularly important, because they address oil pollution before and during its occurrence. Environmental regulations provide the legal and institutional framework for controlling petroleum activities, enforcing environmental standards, monitoring compliance, and ensuring that

oil-producing companies operate in ways that minimize environmental degradation. Oil spill prevention measures, on the other hand, involve proactive actions such as routine inspection and maintenance of pipelines, leak detection, corrosion control, integrity testing, operational safety practices, risk assessment, and continuous environmental monitoring.

Environmental regulations constitute an important mechanism for controlling the environmental consequences of petroleum exploration and production. Effective environmental regulation establishes standards for pollution control, environmental monitoring, operational compliance, and protection of water resources. Regulatory enforcement also provides institutional mechanisms through which petroleum operators can be held accountable for activities that threaten environmental quality. The effectiveness of such regulations therefore depends not only on the existence of environmental laws but also on their consistent implementation, monitoring, and enforcement. The World Health Organization (WHO, 2022) emphasized that public confidence in drinking water safety depends not only on the actual quality of water but also on the effectiveness of environmental monitoring, regulatory enforcement, and public communication. Transparent environmental regulation and timely dissemination of environmental information can enhance public confidence in water safety and encourage appropriate water-use behaviours. Ibrahim and Bello (2023) found that effective environmental governance enhanced residents' trust in environmental institutions and improved their assessment of local environmental quality. The OECD (2021) and the World Health Organization (2022) likewise maintained that transparent environmental regulation, continuous monitoring, and effective enforcement improve public confidence in environmental safety and water quality.

The relationship between environmental regulations and residents' perception of water quality is particularly important in oil-producing communities. Where environmental standards are effectively enforced, petroleum operators are more likely to comply with pollution-control requirements, while regulatory agencies are better positioned to monitor environmental conditions and respond to violations. Consistent enforcement can consequently strengthen institutional accountability and improve public confidence in environmental governance and the safety of available water resources. Conversely, weak regulatory enforcement, delayed interventions, and inadequate environmental monitoring may contribute to negative perceptions of water quality even where environmental management activities are undertaken.

Oil spill prevention measures represent another critical component of oil spillage management. Prevention is a proactive approach aimed at minimizing the occurrence of oil spill incidents before they result in environmental degradation. Unlike measures that are implemented after a spill has occurred, prevention focuses on identifying and reducing potential risks through effective planning, technological innovation, operational safety, infrastructure maintenance, and compliance with environmental requirements. Prevention is therefore regarded as an important and environmentally sustainable approach to oil spill management because reducing the occurrence of spills also reduces the likelihood of contamination and the associated ecological, economic, and public health consequences (International Association of Oil and Gas Producers [IOGP], 2020).

Oil spill prevention measures commonly include routine inspection and maintenance of pipelines, corrosion control programmes, leak detection systems, integrity testing of petroleum facilities, risk assessment, operational safety procedures, employee training, and continuous environmental monitoring. Modern petroleum operations also increasingly employ technologies such as real-time pipeline monitoring systems, geographic information systems (GIS), drones, fibre-optic sensors, and automated leak detection technologies to identify faults before they develop into major spill incidents. These preventive measures reduce operational risks and contribute to environmental sustainability by minimizing the release of petroleum hydrocarbons into surrounding ecosystems (Ola et al., 2024).

The effectiveness of oil spill prevention measures depends largely on organizational commitment, investment in infrastructure, technological capacity, and adherence to environmental regulations. In many developing countries, however, ageing pipelines, deferred maintenance, equipment failure, illegal pipeline connections, and inadequate investment in preventive technologies continue to increase the vulnerability of petroleum infrastructure to oil spills. Consequently, preventive maintenance remains a major environmental management challenge within many oil-producing regions (Ebisi, 2025).

Residents' perception of water quality is an important dimension of environmental quality in oil-producing communities. Water quality perception refers to residents' assessment or judgment concerning the safety, cleanliness, suitability, and usability of available water resources for domestic, agricultural, and other purposes. Such perceptions may be influenced by visible environmental conditions, experiences with oil pollution, changes in water characteristics, environmental monitoring, and confidence in institutions responsible

for protecting water resources. In communities where residents depend heavily on local surface water and groundwater, oil contamination can generate concerns about the safety and suitability of available water resources. Consequently, residents' perception provides an important social dimension for assessing the effectiveness of environmental management interventions.

In Ohaji/Egbema Local Government Area of Imo State, the issue is particularly significant because petroleum exploration and related activities have created environmental concerns within host communities. Oil-producing communities depend on surrounding water resources for domestic activities, agriculture, fishing, and other livelihood activities. Consequently, oil spills and the possibility of petroleum contamination can influence how residents assess the quality and safety of their water resources. Effective environmental regulations and preventive measures are therefore expected to contribute to improved environmental conditions and greater confidence in the quality of available water.

Existing studies have demonstrated the importance of environmental education, environmental stewardship, public awareness, and sustainable environmental management in promoting positive environmental outcomes. Igwebuike and Agbor (2022) emphasized the role of outdoor education in promoting environmental sustainability, while Orji and Igwebuike (2018) highlighted the importance of environmental stewardship and appropriate curriculum and pedagogical practices in fostering responsible environmental behaviour. Similarly, Igwebuike and Etan (2017) reported the importance of mass media and environmental workshops in promoting sustainable forest resource utilization. These studies provide evidence of the importance of environmental awareness and management practices in environmental sustainability, but they do not specifically establish the influence of environmental regulations on residents' perception of water quality in Ohaji/Egbema Local Government Area. This gap provides justification for the present study.

Despite the growing body of literature on oil pollution and environmental management, there remains a need for localized empirical evidence on how environmental regulations and oil spill prevention measures relate to residents' perception of water quality in Ohaji/Egbema Local Government Area. Much of the existing research has focused on the environmental consequences of oil pollution, the quality of water resources, regulatory effectiveness, and oil-spill management in Niger Delta communities (Ewim et al., 2023; Amadi et al., 2026). However, limited empirical attention has been given to the specific relationship between environmental regulations, oil-spill prevention measures, and

residents' perception of water quality in Ohaji/Egbema Local Government Area, thereby creating a localized research gap that the present study addresses concentrated on regulatory compliance, environmental performance, institutional effectiveness, or the physical consequences of oil pollution; while comparatively less attention has been devoted to residents' perception of water quality as an outcome of environmental management interventions. It is against this background that the present study focuses specifically on environmental regulations and oil spill prevention measures and their influence on residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State

Statement of the problem

Oil exploration and production have contributed significantly to Nigeria's economic development, particularly in oil-producing communities such as Ohaji/Egbema Local Government Area of Imo State. However, these activities have also been associated with recurring oil spill incidents arising from pipeline failures, equipment malfunction, operational errors, vandalism, and illegal refining. The persistent occurrence of oil spills has heightened residents' concerns regarding the safety, cleanliness, and suitability of available water sources for domestic and livelihood purposes. To address these challenges, government agencies and oil companies have implemented environmental regulations and oil spill prevention measures intended to minimize pollution and protect water resources. However, concerns persist regarding the effectiveness and consistent implementation of these measures.

In Ohaji/Egbema, recurring oil spill incidents and concerns over rivers, streams, boreholes, and wells have continued to raise questions about the quality of available water. Residents' perception of water quality may therefore be influenced by how effectively environmental regulations are enforced and how adequately oil spill prevention measures are implemented. Although several studies have examined the environmental and health consequences of oil spills in the Niger Delta, limited attention has been given to how environmental regulations and oil spill prevention measures relate to residents' perception of water quality, particularly in Ohaji/Egbema Local Government Area. This gap in localized empirical evidence necessitates the present study.

Objectives of the study

Specifically, the study seeks to:

1. Examine the relationship between environmental regulations for oil spill management and residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State.
2. Determine the relationship between oil spill prevention measures and residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State.

Research questions

The following research questions guided the study:

1. To what extent do environmental regulations for oil spill management relate to residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State?
2. How does oil spill prevention measures relate to residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State?

Hypotheses

The following hypotheses were formulated to guide the study:

Ho1: Environmental regulations for oil spill management have no significant relationship with residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State.

Ho2: Oil spill prevention measures have no significant relationship with residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State.

Methodology

The study adopted a descriptive correlational survey research design. The descriptive aspect of the design facilitated the systematic collection of information on respondents' perceptions of environmental regulations, oil spill prevention measures, and perceived water quality. The study was conducted in Ohaji/Egbema Local Government Area (LGA), located in the southwestern part of Imo State, Nigeria. Ohaji/Egbema is one of the twenty-seven Local Government Areas in Imo State and forms part of the Niger Delta region, which is renowned for its abundant petroleum resources and extensive oil exploration activities.

The population of this study comprises 148,661 adult residents (18 years and above) living in oil-producing communities within Ohaji/Egbema Local Government Area of Imo State. According to population projections by the National Bureau of Statistics (NBS) and other

demographic estimates, the population of the Local Government Area is estimated to be approximately 148,661 people in 2025. The sample for this study consisted of 422 adult residents selected from five oil-producing communities in Ohaji/Egbema Local Government Area of Imo State. The five communities were purposively selected based on their direct exposure to petroleum exploration and oil-spill activities, after which the 422 respondents were proportionately allocated according to the population size of each community. Eligible residents aged 18 years and above were then selected from each community using simple random sampling. The respondents were selected because they are directly exposed to the environmental impacts of petroleum exploration and are users of surface water, boreholes, streams, rivers, and other domestic water sources within their communities.

Data for the study were collected using a researchers-developed structured questionnaire titled Environmental Regulations, Oil Spill Prevention Measures and Residents' Perception of Water Quality Questionnaire (EROSPRPWQ). The questionnaire comprised four sections: Section A contained 5 items on respondents' demographic characteristics; Section B contained 10 items measuring environmental regulations for oil-spill management; Section C contained 10 items measuring oil-spill prevention measures; and Section D contained 10 items measuring residents' perception of water quality. Sections B–D were rated on a four-point Likert scale of Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1, with higher scores indicating stronger environmental regulation, better prevention measures, and more favourable perceptions of water quality, respectively. The instrument was validated by three experts in Environmental Education and Measurement and Evaluation, who assessed the items for relevance, clarity, and adequacy. Reliability was established through a pilot study involving adult residents from a similar oil-producing community outside the sampled communities; the pilot data were analysed using Cronbach's alpha, which yielded an overall reliability coefficient of .84, indicating satisfactory internal consistency.

Copies of the questionnaire were administered directly to the selected respondents in the five sampled communities of Ohaji/Egbema Local Government Area of Imo State. The researchers, with the assistance of two trained research assistants familiar with the study area, personally administered 422 copies of the questionnaire to the selected respondents. The purpose of the study was clearly explained to each respondent, and they were assured that participation was entirely voluntary. Respondents were also informed that the

information they provided would be treated with strict confidentiality and used solely for academic purposes.

The instrument was administered using the face-to-face method to ensure a high response rate and to provide clarification where necessary. Respondents were given adequate time to complete the questionnaire, after which the completed copies were retrieved immediately or within seven (7) days, depending on the convenience of the respondents. The data collected for this study were coded and entered into the Statistical Package for the Social Sciences (SPSS) Version 29 for analysis. Pearson Product Moment Correlation (PPMC) was used to test the hypotheses at 0.05 level of significance.

Presentation of results

Ho1: Environmental regulations do not significantly relate to residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State.

Table 1: Pearson Product Moment Correlation analysis of the relationship between environmental regulations and residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State (N = 422)

Variables	N	R	p-value	Decision
Environmental regulations	422	.550	.000	Significant
Residents' perception of water quality	422			

Note: Level of significance = 0.05

The result presented in Table 1 shows the Pearson Product Moment Correlation analysis of the relationship between environmental regulations and residents' perception of water quality in Ohaji/Egbema Local Government Area, Imo State. The analysis yielded a Pearson correlation coefficient of 0.550 with a corresponding p-value of 0.000 ($p < 0.05$), based on 422 respondents.

The positive correlation coefficient indicates a moderate positive relationship between environmental regulations and residents' perception of water quality. This implies that improvements in the effectiveness and enforcement of environmental regulations are associated with more positive perceptions of water quality among residents of the study area. Since the obtained p-value (0.000) is less than the 0.05 level of significance, the null hypothesis, which states that environmental regulations do not significantly relate to residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State, was rejected. The alternative hypothesis was therefore accepted.

The study found that environmental regulations had a statistically significant moderate positive relationship with residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State ($r = .550$, $p < .05$). This finding suggests that effective implementation and enforcement of environmental regulations are associated with improved residents' perceptions of the quality of available water resources.

Ho2: Oil spill prevention measures do not significantly relate to residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State.

Table 2: Pearson Product Moment Correlation analysis of the relationship between oil spill prevention measures and residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State (N = 422)

Variables	N	r	p-value	Decision
Oil spill prevention measures	422	.473	.000	Significant
Residents' perception of water quality	422			

Note: Level of significance = 0.05

The result presented in Table 2 shows the Pearson Product Moment Correlation analysis of the relationship between oil spill prevention measures and residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State. The analysis produced a Pearson correlation coefficient of 0.473 with a corresponding p-value of 0.000 ($p < 0.05$), based on 422 respondents.

The positive correlation coefficient indicates a moderate positive relationship between oil spill prevention measures and residents' perception of water quality. This implies that effective implementation of oil spill prevention measures is associated with more favourable perceptions of water quality among residents in the study area. In other words, as preventive measures such as routine pipeline maintenance, leak detection, operational safety practices, and regular inspections improve, residents are more likely to perceive the available water sources as being of better quality. Since the obtained p-value (0.000) is less than the 0.05 level of significance, the null hypothesis, which states that oil spill prevention measures do not significantly relate to residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State, was rejected. The alternative hypothesis was therefore accepted. This finding indicates that improved oil spill

prevention measures are associated with more positive perceptions of water quality among residents of the study area.

Discussion of the findings

The study found that environmental regulations had a significant moderate positive relationship with residents' perception of water quality in Ohaji/Egbema Local Government Area ($r = .550, p < .05$). This indicates that improved enforcement of environmental laws, regular environmental monitoring, and compliance with petroleum environmental standards are associated with more positive perceptions of water quality among residents. The finding supports the proposition of the Environmental Degradation Theory that effective environmental control mechanisms reduce pollution and promote environmental sustainability.

The finding agrees with Ebisi (2025), who reported that effective environmental regulations strengthen environmental protection and improve public confidence in environmental governance despite persistent institutional challenges. It also corroborates the findings of Ola et al. (2024), who observed that strict regulatory enforcement significantly improved environmental management outcomes and increased community confidence in environmental quality. Similarly, Ibrahim and Bello (2023) found that effective environmental governance enhanced residents' trust in environmental institutions and improved their assessment of local environmental quality. The OECD (2021) and the World Health Organization (2022) likewise maintained that transparent environmental regulation, continuous monitoring, and effective enforcement improve public confidence in environmental safety and water quality.

The moderate relationship obtained in the present study suggests that although environmental regulations are important determinants of residents' perception of water quality, their effectiveness depends on the extent to which regulatory agencies consistently enforce existing environmental laws. The study therefore provides localized empirical evidence from Ohaji/Egbema, an area that has received relatively limited research attention despite its growing oil exploration activities.

The study also established that oil spill prevention measures had a significant moderate positive relationship with residents' perception of water quality ($r = .473, p < .05$). This implies that effective pipeline maintenance, leak detection systems, routine inspection, operational safety practices, and preventive environmental monitoring contribute to positive perceptions of water quality among residents.

The finding is consistent with Ola et al. (2024), who found that organizations implementing proactive pipeline integrity management and preventive maintenance recorded fewer spill incidents and better environmental performance. It also agrees with Ebisi (2025), who concluded that proactive environmental management contributes significantly to environmental sustainability and public confidence. Similarly, the International Association of Oil and Gas Producers (2020) reported that systematic preventive maintenance, infrastructure modernization, and continuous monitoring substantially reduce the occurrence of oil spills and their environmental consequences,

The moderate strength of the relationship indicates that prevention remains an essential component of oil spillage management. However, prevention alone cannot completely eliminate operational risks associated with petroleum exploration. The finding therefore reinforces the need for continuous investment in modern preventive technologies and infrastructure maintenance within oil-producing communities such as Ohaji/Egbema.

Conclusion

This study examined the influence of environmental regulations and oil spill prevention measures on residents' perception of water quality in Ohaji/Egbema Local Government Area of Imo State, Nigeria. The findings established that environmental regulations, and oil spill prevention measures, both had significant positive relationships with residents' perception of water quality. This indicates that effective implementation of these management strategies contributes to improved public confidence in the quality and safety of available water resources. Based on these findings, it was therefore concluded that improving residents' perception of water quality in oil-producing communities requires an integrated oil spillage management framework that combines effective environmental regulation, proactive spill prevention strategies; and that these will not only enhance public confidence in water quality but also promote environmental sustainability, protect public health, and improve environmental governance in Ohaji/Egbema Local Government Area and other oil-producing communities in Nigeria.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Government regulatory agencies, particularly the National Oil Spill Detection and Response Agency (NOSDRA), the Nigerian Upstream Petroleum Regulatory Commission (NUPRC), and relevant state environmental agencies, should intensify the enforcement of

environmental laws and ensure strict compliance by oil companies with environmental standards, pollution control measures, and remediation obligations.

2. Oil companies should invest in modern pipeline monitoring technologies, routine infrastructure maintenance, corrosion control programmes, and leak detection systems to minimize the occurrence of oil spills. Regular inspection of petroleum facilities should also be strengthened to reduce operational failures that may result in environmental pollution.

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