Environmental Cost Disclosures and Sustainability Performance of Listed Oil and Gas Firms in Nigeria: Does Green Innovation Matter?

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Abstract: *This study explores the moderating role of green innovation on the connection between environmental cost disclosures and the sustainability performance of listed oil and gas firms in Nigeria. The population comprised all listed oil and gas firms in Nigeria, and a non-probability sampling technique of convenience was used to determine 150 participants with primary data as the major instrument of data collection from a structured questionnaire. The administered questionnaires were analysed using descriptive and inferential statistics. The regression analysis reveals that compliance and regulatory cost disclosure has no significant effect on the social performance, that pollution control and abatement cost disclosure has a significant effect on the social performance, resource use and conservation cost disclosure has a significant effect on the social performance and remediation and restoration cost has significant effect on the social performance of listed oil and gas firms in Nigeria. Also, the findings disclose that compliance and regulatory cost disclosure has a significant effect on economic performance, pollution control and abatement cost disclosure has a significant effect on economic performance, resource use and conservation cost disclosure has a significant effect on economic performance and remediation and restoration cost has a significant effect on the economic performance of listed oil and gas firms in Nigeria. Additionally, the findings reveal that green innovation does significantly moderate the relationship between environmental cost disclosures on social and economic performance of listed oil and gas firms in Nigeria. In conclusion, the study underscores that green innovation acts as a strategic enabler, strengthening the link between environmental accountability and sustainable performance. Therefore, oil and gas firms in Nigeria should not only comply with environmental reporting requirements but also embed innovation into their operational and strategic frameworks.*
Keywords: environmental cost disclosure, green innovation, sustainability performance, oil and gas firms, Nigeria.

INTRODUCTION

The world's growing concern over the impact of commercial operations on the ecosystem has prompted corporations to implement more effective environmental management systems. Setaiwan and Honesty (2020), Sundarasen et al. (2024), Ifada and Jaffar (2023) explain that ecological challenges have now become society's consideration, which is very significant to debate. Ofurum and Iwuna (2022) stress that environmental degradation and hazardous wastes are on the increase, threatening the ecosystem and the stability of the economic system. Nahiba (2017) emphasised the need for sustainability of the environment, which has resulted in governmental and non-governmental bodies setting environmental standards. Firms have a great responsibility to operate their business operations socially and responsibly. According to Nguyen et al. (2021), the purpose is that their business operations impact society and determine the extent to which consumers associate with such a business entity. Akinadewo et al. (2023) maintain that alarms have been elevated over the operations of most firms and their harmful consequences in terms of economic, social, and environmental impacts on the atmosphere because of global warming, environmental degradation, etc., in recent decades. Consequently, the sustainability of firms can be determined by the effective and efficient management of their ecosystem for the long-term growth and development of businesses. Ayinla et al. (2024) opine that the advent and relevance of environmental cost disclosures within sustainable accounting practices have become increasingly relevant. Ifada and Jaffar (2023) argue that this elevates numerous demands for corporations to pay more attention to responsibility and to be responsible for environmental situations and the surrounding community. The authors further argue that this change shows an increasing recognition of the critical role that environmental considerations play in the long-term viability and ethical responsibility of businesses.

The wish to guarantee sustainability, business activities have obliged corporations to develop different approaches to improving commercial processes. To this end, organisations are now exploring ecologically friendly production methods that guarantee minimal damage to the environment such as environmental cost disclosure (Ebiaghan 2020; Omaliko et al., 2020; Madawa & Ebiaghan, 2022). Environmental disclosure refers to any public information characteristically contained in a firm's annual report relating to activities classified under corporate social responsibility also referred to as sustainability or eco-reports (Madawa & Ebiaghan, 2022). According to Yahaya (2025), corporate environmental disclosure (CED) is the process by which corporations report their environmental impact, policies, and sustainability initiatives to stakeholders. It covers information on carbon emissions, energy consumption, water usage, waste management, biodiversity conservation, and climate change mitigation strategies. Oshiole et al. (2020) emphasized that appropriate disclosure of accounting information relating to the environment is a very central aspect of accountability. Hence, environmental cost disclosure enables firms and other organizations to improve their public trust and confidence. Wang et al (2020) described environmental costs are costs associated with the actual or potential deterioration of natural assets due to the economic activities of companies. Onyeneho and Inyiama (2023) explain that environmental costs are those incurred by organisations, directly or through third parties, to prevent, reduce or repair damage to the environment arising from their operating

activities and these cost include waste disposal and measures taken to prevent its formation; protection of the soil, surface waters and ground waters; protection of air and climate from pollution; reduction of noise pollution; biodiversity and landscape protection.

In recent years, the concept of sustainability has become central to corporate strategy and reporting. Among the various facets of sustainability, environmental cost disclosures have gained prominence as a key element of transparency and accountability (Jaber & Zerkot, 2023; Oshiole, 2020). Environmental cost disclosures refer to the systematic reporting of financial expenditures and liabilities related to environmental protection, such as waste management, pollution control, and resource conservation (Piwowar-Sulej & Igbal, 2023; Khan & Bhatti, 2020). These disclosures provide stakeholders with critical insights into how organisations are managing their environmental responsibilities (Dwikritina et al., 2024). Environmental cost disclosures serve as a tangible reflection of a firm's environmental management efforts. By making these costs explicit, firms demonstrate their commitment to reducing environmental impact, often signalling superior sustainability performance. Such transparency can improve stakeholder trust and corporate reputation, creating competitive advantages in market practices (Agustin & Basuki, 2025; Oraka, 2021). Additionally, environmental cost disclosures align with sustainability reporting frameworks, notably the Global Reporting Initiative (GRI), which encourages firms to report not only qualitative environmental information, but also quantitative financial data linked to environmental efforts (GRI, 2021). Sustainability performance itself is a multidimensional concept covering environmental, social and economic outcomes (Dwikritina et al., 2024). Within this framework, environmental cost disclosures act as a critical metric that connects financial accounting with environmental stewardship. Earlier research has demonstrated a positive association between environmental cost disclosures and improved environmental performance outcomes (Agustin & Basuki, 2025; Newstyle & Lawson, 2024; Oraka, 2021; Jaber & Zerkot, 2023; Oshiole, 2020).

Green innovation is a strategy to achieve the firm's premeditated goals with techniques, systems and practices to reduce the effect of ecological damage (Dewi & Rahmianingsih, 2020). It is a case of a positive approach for firms to build pro-ecological initiatives as part of their eco-friendly assurance. Gyamfi, et al. (2022); Huang and Li (2017) and Agustia, et al. (2019) state that green innovation involves the development of green technologies and practices that result in a low impact on the environment, minimize greenhouse gas emissions, conserve natural resources, and encourage sustainable development. According to Dwichristiana et al. (2024), green innovation refers to various innovations that enable the reduction of negative impacts on the environment, thereby providing great opportunities for firms to realize ecofriendly performance targets and advantages both the physical and social environments. It is an approach that integrates environmental sustainability into business processes, products and services (Dwikristina et al., 2024. Thus, it helps utilize natural resources more efficiently, reduce carbon emissions, and minimize negative impacts on the environment (Yadav et al., 2024). Soewarno, et al. (2019) argue that implementing green innovation may help businesses meet stakeholder expectations, fulfill consumer needs, and enhance their competitive advantage. The argument for green innovation as a moderating variable in this study is also supported by several previous studies that show green innovation has a positive effect on firm performance (Al-Mesaiaseen et al, 2022; Novitaisari &

Agustia, 2021; Ha & Nguyen, 2022; Nureen et al., 2023; Maldonado-Guzman et al, 2023). Furthermore, previous studies by Fatoki (2021); Yang and Jiang (2023); Ciasullo, et al. (2022) and Agustin and Basuki (2025) have also empirically found that environmental orientation positively affects green innovation.

Despite increasing regulatory and stakeholder pressure for firms to disclose environmental costs, the direct effect of these disclosures on sustainability performance remains ambiguous. Studies in China and Indonesia have shown that while environmental disclosure improves firm value and financial performance, the effectiveness of these disclosures is often contingent upon contemporary factors, such as green innovation (Liu et al., 2025). For example, research in China reveals that green innovation significantly moderates the positive effect of carbon information disclosure on firm value, especially under supportive environmental regulations (Lui et al, 2025; Huang et al., 2025; Lui etal, 2024; Yang & Zhou, 2022). Similarly, studies in Indonesia emphasise that green innovation, combined with transparent environmental disclosures, can enhance sustainability performance (Fristina et al., 2023; Dwikristina et al., 2024; Agustin & Basuji, 2025; Mulatsih, 2025). In the Nigerian context, the evidence also highlights the serious influence of environmental disclosure practices on influencing sustainability outcomes. Nwaiwu and Oluka (2018), Falack et al (2020), Oraka (2021), Ofurum and Iwunna (2022), Akinadewo et al (2023), Newstyle and Lawson (2024), Aguguom (2024), Ali-Momoh et al. (2025) studies revealed that environmental disclosures significantly influence the performance of firms in Nigeria. However, the association between sustainability reporting and firm value can be complex, with some studies indicating that certain forms of environmental reporting may not directly translate into better performance without the support of green initiatives. Despite this, green innovation remains underexplored as a moderating factor in Nigeria's environmental disclosure studies. This gap in literature suggests a need to investigate how green innovation moderates the relationship between environmental cost disclosures and sustainability performance.

This study contributes to literature in several ways. First, it provides empirical evidence on the relationship between environmental cost disclosures and sustainability performance, offering new insights into the financial implications of sustainability practices. Secondly, it advances theoretical understanding by examining the moderating role of green innovation, demonstrating how corporate technological capabilities can amplify the benefits of environmental accountability and transparency. Thirdly, it extends prior research by exploring the moderating effect of green innovation on environmental cost disclosures and sustainability performance. Finally, this study provides practical implications to policymakers, investors, and corporate managers by understanding the relevance of integrating green innovation with environmental cost disclosures to optimize sustainability performance.

The major objective of this is to investigate the moderating effect of green innovation on the relationship between environmental cost disclosures and sustainability performance of listed oil and gas firms in Nigeria. The specific objectives are designed to:

1. ascertain the effect of compliance and regulatory cost disclosure on the social performance of listed oil and gas firms in Nigeria.

2. determine the effect of pollution control and abatement cost disclosure on the social performance of listed oil and gas firms in Nigeria.
3. evaluate the effect of resource use and conservation cost disclosure on the social performance of listed oil and gas firms in Nigeria.
4. Examine the effect of remediation and restoration cost disclosure on the social performance of listed oil and gas firms in Nigeria.
5. investigate the effect of compliance and regulatory cost disclosure on the economic performance of listed oil and gas firms in Nigeria.
6. examine the effect of pollution control and abatement cost disclosure on the economic performance of listed oil and gas firms in Nigeria.
7. evaluate the effect of resource use and conservation cost disclosure on the economic performance of listed oil and gas firms in Nigeria.
8. ascertain the effect of remediation and restoration cost disclosure on the economic performance of listed oil and gas firms in Nigeria.
9. investigate the moderating effects of green innovation on the relationship between environmental cost disclosures and social performance of listed oil and gas firms in Nigeria.
10. investigate the moderating effects of green innovation on the relationship between environmental cost disclosures and economic performance of listed oil and gas firms in Nigeria.

This study analysed the following research questions:
1. Does compliance and regulatory cost disclosure affect the social performance of listed oil and gas firms in Nigeria?
2. What is the effect of pollution control and abatement cost disclosure on the social performance of listed oil and gas firms in Nigeria?
3. Does resource use and conservation cost disclosure affect the social performance of listed oil and gas firms in Nigeria?
4. What is the effect of remediation and restoration cost disclosure on the social performance of listed oil and gas firms in Nigeria?
5. Does compliance and regulatory cost disclosure affect the economic performance of the listed oil and gas firm in Nigeria?
6. What is the effect of pollution control and abatement cost disclosure on the economic performance of the listed oil and gas firms in Nigeria?
7. Does resource use and conservation cost disclosure affect the economic performance of listed oil and gas firms in Nigeria?
8. What is the effect of remediation and restoration cost disclosure on the economic performance of listed oil and gas firms in Nigeria?
9. Does green innovation moderates on the relationship between environmental cost disclosures and social performance of listed oil and gas firms in Nigeria?

10. Does green innovation moderates on the relationship between environmental cost disclosures and economic performance of listed oil and gas firms in Nigeria?

This study tested the following null hypotheses:

Ho₁: Compliance and regulatory cost disclosure has no significant effect on the social performance of listed oil and gas firms in Nigeria.

Ho₂: Pollution control and abatement cost disclosure has no significant effect on the social performance of listed oil and gas firms in Nigeria.

Ho₃: Resource use and conservation cost disclosure has no significant effect on the social performance of listed oil and gas firms in Nigeria.

Ho₄: Remediation and restoration cost disclosure has no significant effect on the social performance of listed oil and gas firms in Nigeria.

Ho₅: Compliance and regulatory cost disclosure has no significant effect on the economic performance of the listed oil and gas firms in Nigeria.

Ho₆: Pollution control and abatement cost disclosure has no significant effect on the economic performance of listed oil and gas firms in Nigeria.

Ho₇: Resource use and conservation cost disclosure has no significant effect on the economic performance of listed oil and gas firms in Nigeria.

Ho₈: Remediation and restoration cost disclosure has no significant effect on the economic performance of listed oil and gas firms in Nigeria.

Ho₉: Green innovation does not significantly moderate the relationship between environmental cost disclosures and the social performance of listed oil and gas firms in Nigeria.

Ho₁₀: Green innovation does not significantly moderate the relationship between environmental cost disclosures and the economic performance of listed oil and gas firms in Nigeria.
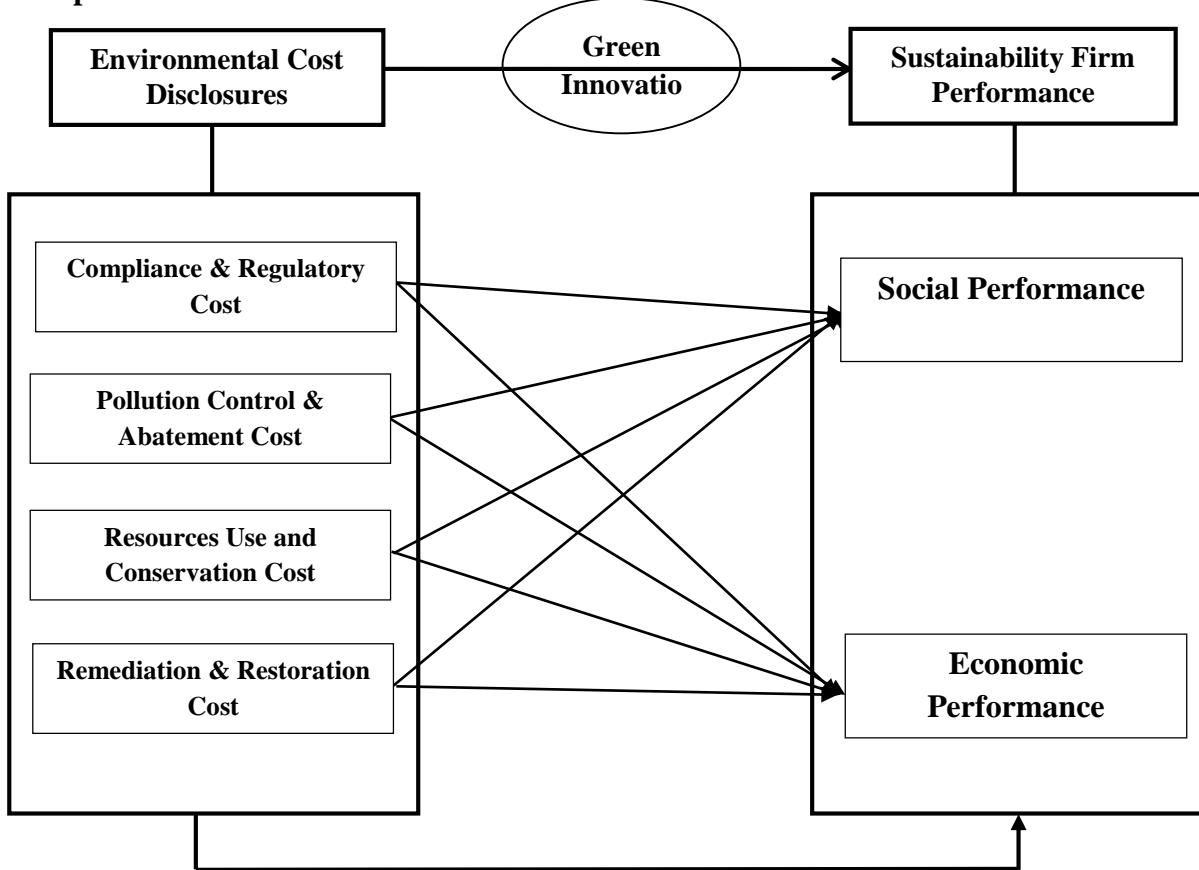
LITERATURE REVIEW

Conceptual Review

Figure 1: Conceptual Framework Authors Creation

Concept of Environmental Cost Disclosure: Environmental cost disclosures generally refer to the systematic reporting of costs that an organization incurs due to its environmental impacts, obligations, or sustainability initiatives (Ali-Momoh et al., 2025). It refers to the process by which organisations identify, measure, record, and publicly report the costs associated with their environmental impacts. These costs typically include expenses related to pollution prevention, waste management, resource conservation, remediation, compliance with regulations, and corporate social responsibility activities linked to the environment (Fritiani et al., 2023). These disclosures are important for transparency, accountability, and sustainability performance evaluation. The dimensions of environmental cost disclosures usually cover compliance and regulatory costs, pollution control and abatement costs, resource use and conservation costs, product and process design costs, remediation and restoration costs, training, research, and developments costs, corporate social responsibility reporting costs (Ugwuanyi, et al., 2023; Uwuigbe et al., 2021; Setiawan & Honesty, 2020). Oshiole et al. (2020) explain that environmental costs are one of the various types of costs companies incur to deliver goods and services to their customers. Ifada and Jaffar (2023) explained that the usefulness of environmental cost expenditure

comprised two diverse perspectives of assessing current alternative environmental projects, and the future environmental performance of the firm. Firms invest substantially by establishing several environmental plans with definite environmental budget allocations to decrease the consumption of natural resources in their manufacturing process, reduction of production expenditure (Gupta et al, 2019), and advance manufacturing efficiency and financial performance. **Compliance and Regulatory Cost Disclosure:** Compliance and regulatory disclosure costs are the expenses a firm incurs to comply with environmental regulations, such as laws on emissions, waste management, water use, oil spill control, environmental audits, and safety standards. It discloses relevant information about compliance activities to regulators, investors, and the public through sustainability reports, annual reports, and environmental disclosures (Ofurum & Iwuna, 2022; Oraka, 2021; Oshiole et al., 2020). These costs may include environmental audit fees, monitoring and reporting expenses, costs of obtaining permits and licenses, penalties and fines for non-compliance, legal and consultancy fees for compliance-related issues and expenditure on systems to measure, record, and disclose compliance data (Fritiani et al., 2023; Oraka, 2021; Falack et al., 2020). **Pollution Control and Abatement Disclosure Cost:** Pollution and abatement disclosure costs are expenditures a firm incurs to control, reduce, or eliminate pollutants released during its operations, and the costs associated with reporting such efforts in environmental reports (Fritiani et al., 2023; Oraka, 2021; Oshiole, et al, 2020). These costs include investments in pollution-control technologies such as filters, scrubbers, wastewater treatment plants, operational costs of running abatement equipment, waste treatment and recycling expenses, air, water, and soil pollution mitigation costs, expenses on emissions monitoring, testing and disclosure, environmental restoration and clean-up costs and reporting and disclosure costs related to pollution control activities (Oraka, 2021; Falack et al., 2020). **Resources Use and Conservation Cost Disclosure:** Resource use and conservation disclosure cost refers to the expenses incurred by firms in identifying, measuring, reporting, and communicating information related to how they consume natural resources, such as water, energy, raw materials, and land and the measures they take to conserve, recycle, or manage these resources sustainably (Yahaya, 2025; Emeny & Okpokpo, 2023; Jaber & Zerkot, 2023; Al-Anassri, 2023; Enekwe et al., 2023). It is a dimension of environmental cost disclosure that ensures stakeholders are informed about a company's efforts toward responsible resource management and environmental sustainability (Ntiamoah et al, 2025; Onyenebo & Inyiamo, 2023). According to Wulaningrum & Kusrihandayani (2020) explain that the components of resource use and conservation disclosure cost consist of resource extraction and consumption reporting cost, conservation and efficiency initiative disclosure costs, compliance costs, communication and reporting costs. Al-Mawali (2021) maintain that resource use and conservation costs disclosure builds stakeholder trust and improves corporate reputation, links resource efficiency to environmental performance and long-term profitability and assists firms in meeting national and international environmental disclosure requirements. **Remediation and Restoration Cost Disclosure:** Remediation and restoration cost disclosure is a key component of environmental cost disclosure, representing the expenses and information firms provide about efforts to clean up, restore, or rehabilitate environments negatively impacted by their operations (Ntiamoah et al, 2025; Yahaya, 2025; Emeny & Okpokpo, 2023; Al-Mawali, 2021). Wulaningrum and Kusrihandayani (2020) mentioned that these disclosures demonstrate accountability and compliance with environmental standards, while also reflecting a firm's commitment to sustainable development. Al-Mawali (2021) argues that remediation and restoration cost

disclosure involves the recognition, measurement, and reporting of costs incurred to remediate a polluted site (e.g., soil decontamination, oil spill clean-up, toxic waste management) and restore the natural environment to its original or improved condition 9e.g., reforestation, land reclamation, wetland restoration). According to Ntiamoah et al. (2025) the components of remediation and restoration costs comprised pollution clean-up costs, site rehabilitation costs, ecosystem restoration costs, legal and regulatory compliance costs, and monitoring and reporting costs. Emeny and Okpokpo, (2023), Jaber and Zerkot (2023), and Al-Mawali (2021) listed the significance of remediation and restoration cost disclosure as enhancing trust with investors, regulators, and communities, provision of insights into contingent liabilities and long-term financial obligations and a reflection of corporate social responsibility and commitment to the environment.

Concept of Sustainability Firm Performance: Sustainability firm performance refers to the extent to which organisations integrate and balance economic, environmental, and social objectives in their operations to ensure long-term value creation while minimizing negative impacts on stakeholders and the natural environment. It is rooted in the triple bottom line (TBL) framework, which emphasizes "people, planet, and profit as core pillars of sustainable development (Elkington, 1997). According to the Global Reporting Initiative (GRI, 2016), sustainability performance captures an organisation's contribution to sustainable development through disclosures on its economic, environmental, and social impacts. This includes how communities and employees are treated, and how governance structures ensure transparency and accountability. Scholars note that sustainability performance goes beyond mere compliance with regulations; it reflects proactive strategies adopted by firms to achieve competitive advantage and legitimacy (Burritt & Schaltegger, 2010). In this view, firms that perform well on sustainability are those that balance profit-making with environmental stewardship and social responsibility, thereby creating long-term value for shareholders and stakeholders alike. Okafor and Ujah (2020) showed that oil and gas companies' disclosure of environmental costs was linked to improved legitimacy and stakeholder trust. Sustainability performance is generally conceptualised through three core dimensions – environmental, social, and economic/governance-with some scholars adding a fourth, the institutional/regulatory dimension, to capture compliance with global standards. The environmental dimension evaluates how firms manage their ecological footprint through resource efficiency, pollution control, carbon reduction, biodiversity protection, and the adoption of green technologies. Okafor and Ujah (2020) reported that Nigerian oil companies disclosed environmental initiatives such as spill remediation and pollution abatement in response to regulatory and stakeholder pressures. The social dimension reflects the impact of organizational activities on people and communities. It covers indicators such as employee welfare, training, diversity, safety, community development, human rights protection, and stakeholder relations. The economic or governance dimension emphasizes value creation, corporate accountability, and ethical business practices. It includes profitability, risk management, corporate governance, anti-corruption mechanisms, tax transparency and innovation. Finally, the institutional/regulatory dimension addresses compliance with local and international standards, including the Global Reporting Initiative (GRI), the United Nations Sustainability Development Goals (SDGs), and industry-specific environmental laws.

Green Innovation: This refers to the development of sustainable products, services, and processes that minimize environmental damage and promote eco-efficiency (Lui, et al, 2025). It involves applying eco-design principles and environmentally friendly materials during the manufacturing or design process (Takalo & Tooranloo, 2021). The goal is to reduce negative environmental impacts while improving economic and social performance (Li et al., 2020). According to Ren and Mia (2025), green innovation encompasses the development and application of new or improved products, processes, organisational practices, or business models that reduce environmental impacts and improve resource efficiency. Recent empirical evidence has emphasised the strategic role of green innovation in achieving sustainability performance, specifically, in response to stakeholders' expectations and growing international concerns. Firms that proactively invest in green innovation not only gain a competitive advantage but also demonstrate superior performance in environmental and social performance metrics (Rupasinghe et al, 2024). As such, green innovation is increasingly viewed as a dynamic capability that enables firms to respond effectively to environmental challenges and integrate sustainability into core business practice. In the context of environmental disclosure, green innovation plays an important moderating role. While disclosures provide transparency and promote accountability, their impact on sustainability performance may be limited in the absence of the operational capability needed to act on disclosure information. Green innovation improves firm's absorptive capacity to interpret and employ environmental information, thus facilitating the implementation of more effective sustainability initiatives (Austin & Basuki, 2025. As such, firms with high levels of green innovation are more likely to convert environmental cost disclosures into tangible environmental performance gains, reinforcing the positive linkage between disclosure and sustainability (Dwikristina et al., 2024; Ren & Mia, 2025). Prior studies done by Ha and Nguyen (2022) and Nureen, et al. (2023) on manufacturing firms in Vietnam and China demonstrate that green innovation has a positive influence on firms' performance due to reduced energy consumption, hazardous materials, waste, and emissions. A study by Maldonado-Guzmán, et al. (2023) on 460 firms in Mexico discloses that the implementation of green innovation will ensure economic, social, and environmental sustainability.

Theoretical Review

This research is grounded in legitimacy theory. Legitimacy theory is based on the idea that organisations operate under a social contract with society, whereby their survival depends on being perceived as acting within socially acceptable norms, values, and expectations (Suchman, 1995). When a firm's activities create environmental harm or raise public concern, a legitimacy gap arises, threatening its ability to operate without resistance. To reduce this gap, firms adopt legitimization strategies, one of the most prominent being environmental cost disclosure. In this context, environmental cost disclosures covering areas such as resource use and conservation, compliance costs, pollution abatement, remediation, and restoration costs serve as mechanisms through which firms demonstrate accountability and responsiveness to stakeholder concerns by voluntarily or mandatorily disclosing environmental costs. Firms seek to enhance transparency and show commitment to sustainability, protect or repair legitimacy after environmental incidents or public criticism, align with regulatory and stakeholder expectations to maintain their social license to operate and signal responsibility to investors, regulators, and the community, thereby reducing

reputational risk (Solomon, 2020). According to Yahaya (2025), companies practice environmental disclosure to improve legitimacy and decrease reputational risks in response to societal and regulatory expectations. The author further maintains that firms in high-polluting activities reveal more environmental information to legitimise their operations and reduce regulatory scrutiny. Akhter et al. (2023) stress that firms disclose remediation and restoration costs to show accountability for past environmental damage and efforts to restore ecosystems, thereby maintaining legitimacy. According to Ali et al (2024), reporting on energy, water, and material efficiency initiatives signals environmental stewardship, reinforcing moral legitimacy. Also, Frisancho et al. (2025) noted that disclosure of regulatory compliance expenditure demonstrates adherence to legal and societal expectations, strengthening pragmatic legitimacy. In this investigation, legitimacy theory explains the significance of corporate environmental cost disclosure and its implications for environmental performance and disclosure (Akhter et al., 2023). The theory offers a basis for increasing firms' resourcefulness in managing the environment in their activities, such as implementing environmental cost disclosure. Corporate environmental cost disclosure leads to the advancement of sustainability performance, which is vital to obtain, maintain and improve a firm's legitimacy in society (Meutia et al., 2022).

Empirical Review

Augstin and Basuki (2025) investigated the mediating influence of green innovation on the association between environmental orientation and firm performance of listed firms in the Indonesian Stock Exchange from 2020 to 2023. The study employed an ex post facto research design, and a population of all listed firms, with a sample size of 153 firms and 612 observations. The study utilised secondary data collected from the annual report and sustainability reports using content analysis. Their study employed environmental orientation as an independent variable, and firm performance as a dependent variable, with green innovation as a mediator variable and firm size, firm age and firm leverage as control variables. The content analysis data were analysed using descriptive statistics, correlation analysis and regression analysis. The findings suggest that environmental orientation had a significantly positive influence on green innovation. Also, there is a significant positive link between green innovation and firm performance. In addition, findings showed that the direct impact of environmental orientation on firm performance was insignificant. Furthermore, the findings established that green innovation mediates the association between environmental orientation and firm performance of listed firms in Indonesia.

Dwikristina et al. (2024) explored the influence of green innovation on the link between critical success factors and the sustainability performance of 96 energy firms in Indonesia. The research philosophy is grounded in positivism, employing a quantitative method. The study employed a survey research design, with the population consisting of energy firms, and stratified random sampling as the sampling technique. The study used primary and secondary data. The primary data was collected from a structured questionnaire. The study employed critical success factors as an independent variable, sustainability firm performance as a dependent variable, and green innovation as a mediator variable. The responses obtained from the questionnaires administered were analysed using descriptive and SEM-PLS path analysis. The results revealed that internal and external success factors significantly influence green innovation and sustainable firm performance

in Indonesia. Green innovation significantly impacts sustainable firm performance in Indonesia. Also, internal and external success influences sustainable firm performance not directly, but through green innovation in Indonesia.

Onyeneho and Inyiama (2023) analysed environmental cost disclosure and productivity of oil and gas companies in Nigeria. The study employed ex post factor research design and a population of 12 listed oil and gas firms with purposive sampling employed to determine the sample size of 7 firms. Secondary sources of data collection were utilized to obtain the data for analysis. Their study employed environmental prevention cost disclosure, community development cost disclosure and environmental remediation cost disclosures (environmental cost disclosures) as independent variables, revenue growth (productivity) as the dependent variable. The secondary data collected from the financial reports of the sampled companies were analysed using univariate and bivariate analysis. The findings from the multiple regression analysis showed that environmental prevention cost disclosure, community development cost disclosure and environmental remediation cost disclosure have a significantly positive effects on revenue growth of oil and gas companies in Nigeria. Hence, the study concluded that environmental cost disclosure significantly influences productivity of oil and gas companies in Nigeria.

Jaber and Zerkot (2023) examined environmental cost disclosure and environmental performance in Lebanon. The study employed survey research design and the population comprised of Certified Public Accountants in Lebanon and simple random sampling techniques was used to derive a sample size of 315 with 300 responded to the study. The study employed primary and secondary data. The primary data was obtained from a well-structured questionnaire after validity and reliability tests. The responses from the questionnaire were analysed using descriptive and inferential statistics. The findings revealed that environmental cost accounting influences decisions which minimises environmental costs and expenses. The findings also suggested that environmental accounting affects competitiveness for the firm's products through promoting products with better environmental specifications.

Goni et al. (2023) conducted a study of the mediating influence of green transformational leadership on the link between green innovation and environmental performance of hotels in Kano. The study employed quantitative research technique. The population comprised of all the hotels in Kano and convenience sampling was used to arrive at a sample size of 670 while 649 respondents were used for data analysis. The study used environmental performance as dependent variable, green innovation as independent variable while green transformational leadership as moderator. Primary and secondary sources of data collection were employed with a questionnaire as the major source of data collection after validity and reliability tests. The responses from the administered questionnaire were tested using descriptive statistics and PLS-SEM analysis for data analysis. The results from the analysis indicated that green innovation had a significantly positive link on environmental performance of sampled hotels in Kano. Also, green transformational leadership style positively and significantly moderates the link between green innovation and environmental hotels in Kano, Nigeria.

Emeyi and Okpokpo (2023) explored the environmental disclosure and quality of financial reports of listed manufacturing firms in Nigeria. The study employed ex post factor research design and a

population of 55 listed manufacturing firms with purposive sampling technique and Yamene formula was used to determine the sample size of 48 firms and only 10 firms were used after sufficient data. Secondary sources of data collection were utilized to obtain the data for analysis. The study employed environmental donations, environmental restoration and environmental waste management as independent variables while quality of financial report was used as the dependent variable. The data collected from the annual reports of sampled firms were analysed using descriptive statistics, correlation and multiple regression analysis. The result from the data analysis revealed that environmental donations and sponsorship and environmental restorations does not significantly influence on the quality of financial reports of manufacturing firms in Nigeria. Also, the findings revealed that environmental waste management does significantly affect the quality of financial reports of manufacturing firms in Nigeria.

Madawa and Ebiaghan (2022) determined the association between environmental cost disclosure and corporate profitability of oil and gas firms in Nigeria. The study employed ex post factor research design and a population of 15 listed oil and gas firms in Nigeria with purposive sampling employed to ascertain a sample size of 10 firms. Secondary sources of data collection were utilized to obtain the data for analysis. The study employed corporate profitability as the independent variables and environmental cost disclosure as the dependent variable. The secondary data collected from the financial reports of the sampled companies were analysed using univariate, bivariate and multivariate analysis. The findings from the multiple regression analysis disclosed that a significantly negative effect between return on equity on environmental cost disclosure, a significantly positive effect between net profit margin and environmental disclosure and no significant effect between earnings per share and environmental cost disclosure of listed oil and gas firms in Nigeria.

Ofurum and Iwunna (2022) investigated environmental cost disclosures and financial performance of listed oil and gas firms in Nigeria. The study employed ex post factor research design and a population of all the listed oil and gas firms with a sample of 13 firms. Secondary sources of data collection were utilized to obtain the data for analysis. The study employed waste management cost and pollution control cost as independent variables while return on assets was used as the dependent variable. The secondary data collected from the financial reports of the sampled companies were analysed using inferential statistics. The result from the analysis revealed that waste management cost has a significantly positive linkage with return on assets of oil and gas companies in Nigeria. Also, pollution control cost has a significantly positive effect on return on assets of oil and gas companies in Nigeria. Hence, the study concluded that environmental cost disclosures significantly influence financial performance of oil and gas firms in Nigeria.

Oshiole et al. (2020) carried a study of environmental cost disclosure and profitability of listed oil and gas firms in Nigeria. The study employed ex post factor research design and a population of 54 upstream oil and gas firms listed on the Nigerian Exchange Group as at 31 December 2019 with purposive sampling employed to determine a sample of 11 firms. The study employed waste management cost, employee health and safety cost and environmental remediation cost as independent variable while net profit margin was used as the dependent variable. Also, firm size, leverage as control variable. The secondary data collected from the financial reports of the sampled companies were analysed using bivariate and multivariate analysis. The result from the multiple

regression analysis showed that waste management cost disclosure, employee health and safety cost disclosure and environmental cost disclosure has a significantly positive influence on net profit margin of listed oil and gas firms in Nigeria.

METHODOLOGY

This study adopted quantitative research design. The population comprised all the oil and gas firms listed on the Nigeria Exchange group as at 31 December 2024 and for the determination of sample size and technique, 150 copies of questionnaire were conveniently distributed among staff of the firms, out of which 123 were completed and returned representing about 82% response rate. The 123 participants were conveniently chosen and seen to have satisfactory understanding and awareness about environmental cost disclosures and sustainability performance. Questionnaire was used as the primary instrument of data collection and data was analysed using univariate and multivariate analysis. Environmental cost disclosure was measured by a scale consisting of compliance and regulatory cost, pollution and abatement cost, resource use and conservation cost, and remediation and restoration cost (Yahaya, 2025; Emeny & Okpokpo, 2023; Jaber & Zerkot, 2023; Al-Anassri, 2023; Enekwe et al., 2023) comprising of five items with a Cronbach alpha of 0.784, 0.843, 0.882, 0.824 and 0.845 respectively. In addition, measurement of sustainability performance was done by adopting a scale consisting of social performance and economic performance from Global Reporting Initiative (GRI, 2016) with a Cronbach alpha of 0.844 and 0.826 respectively. Also, the measurement of green innovation was done by adopting a scale from Dwikristina et al. (2024); Ren and Mia (2025) with a Cronbach alpha of 0.884. All items were measured on a 5 points Likert scale ranging from 1 strongly disagree to 5 strongly agree. To confirm the construct validity and reliability of the adapted scales for this investigation, a pilot survey was carried out to determine the reliability and the validity of the measurements. A total of 40 copies of questionnaires were administered to randomly selected staff of Seplat Energy Plc and Oando Plc and 32 copies of the questionnaire were collected and used for the pilot study. The reliability and validity of the construct were evaluated using the Cronbach alpha (CA) of at least 0.70, and average variance expected (AVE) of at least 0.50 (Hair et al., 2021). The results of the pilot analysis revealed that environmental cost disclosures have a reliability coefficient (CA = 0.760) and validity (AVE = 0.569), while sustainability performance has a reliability coefficient (CA = 0.757) and validity (AVE = 0.620), and green innovation shows a reliability (CA = 0.717) and validity (AVE = 0.581). These show that all the variables used for this study were reliable and fit for running the main analysis. The study is guided by the equation below:

$$SOP = \beta_0 + \beta_1 CRC + \beta_2 PAC + \beta_3 RCC + \beta_4 RRC + \varepsilon \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$ECP = \beta_0 + \beta_1 CRC + \beta_2 PAC + \beta_3 RCC + \beta_4 RRC + \varepsilon \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Where:

SOP = Social Performance, ECP = Economic Performance, CRC = Compliance and Regulatory Cost, PAC = Pollution and Abatement Cost, RCC = Resource Use and Conservation Cost, RRC

=Remediation and Restoration Cost, β_1– β_4 represents the regression coefficient while e the error term.

The work equally evaluated the moderation or interaction effect of green Innovation (GRN) on the relationship between environmental cost disclosures and environmental cost disclosures indices social performance (SOP) and economic performance (ECP) of listed oil and gas firms in Nigeria. The Moderated Multiple Regression (MMR) techniques was used and is specified by adding an interaction term to the unmoderated multiple regression model in equations 1 and 2 to arrive at the following MMR models viz:

$SOP = \beta_0 + \beta_1 CRC + \beta_2 PAC + \beta_3 RCC + \beta_4 RRC + \beta_5 GRN + \beta_6 (CRC * GRN) + \beta_7 (PAC * GRN) + \beta_8 (RCC * GRN) + \beta_9 (RRC * GRN) + \varepsilon$ ……………………………………..………… (2)

$ECP = \beta_0 + \beta_1 CRC + \beta_2 PAC + \beta_3 RCC + \beta_4 RRC + \beta_5 GRN + \beta_6 (CRC * GRN) + \beta_7 (PAC * GRN) + \beta_8 (RCC * GRN) + \beta_9 (RRC * GRN) + \varepsilon$ …………………………..………………………. (4)

Where:
GRN = Green Innovation,
CRC * GRN = Interacting term for compliance and regulatory cost and green innovation
PAC * GRN = Interacting term for pollution and abatement cost and green innovation
RCC * GRN = Interacting term for resource use and conservation cost and green innovation
RRC * GRN = Interacting term for remediation and restoration cost and green innovation

Results and Discussion of Findings
This section evaluated the data from the field in the light of the objectives stated. It is an analysis of the empirical results obtained from primary data collected for this study. It discusses the moderating effect of green innovation on the relationship between environmental cost disclosures and sustainability performance of listed oil and gas firms in Nigeria. The section is arranged in accordance with the objectives and hypotheses of the study.

Table 1: Questionnaire Distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Number of Questionnaires Returned	123	82.0	82.0	82.0
	Number of Questionnaires not Return	16	10.7	10.7	92.7
	Number of Questionnaires not properly filed	11	7.3	7.3	100.0
	Total	150	100.0	100.0	

Table 1 showed that, the researcher distributed a total of 150 questionnaires to the seven (7) listed oil and gas companies in Nigeria, out of these, 123 respondents representing 82.0% filled the questionnaires correctly and returned the questionnaires, whereas 16 respondents representing 10.7% did not returned the questionnaires while 11 respondents representing 7.3% filled the questionnaires wrongly and returned the questionnaires. Due to time constraints the researcher could not continue waiting for the respondents who were not available to return their questionnaire on the appointed date. Therefore, one hundred and twenty-three (123) representing a response rate of 82.0%.was used as new respondents sample size for the study.

Demographic Analysis
This study was interested in the respondents' demographic data characteristics that include gender, working age, work experience, level of education and etc of the respondents drawn from accessible research population of listed oil and gas companies in Nigeria.

Table 2: Gender Distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	FEMALE	47	31.3	31.3	31.3
	MALE	103	68.7	68.7	100.0
	Total	150	100.0	100.0	

The gender distribution presented above in table 2 show that one-hundred and three (103) respondents represented 68.7% of the total respondents were male, while the total number of female respondents was forty-three (47) represented by 31.3% of the entire respondents. The margin in the ratio between the male and female showed that listed oil and gas companies in Nigeria employ more male than female due to the nature of work.

Table 3: Age Range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 – 25 years	14	11.4	11.4	11.4
	26 – 35 years	37	30.1	30.1	41.5
	36 – 45 years	52	42.3	42.3	83.7
	46 – 55 years	20	16.3	16.3	100.0
	Total	123	100.0	100.0	

Results in Table 3 disclosed the age range of the respondents. Fourteen (14) respondents representing 11.4% are between 18 – 25 years of age, 37 respondents representing 30.1% are 26 – 35 years, 52 respondents representing 42.3% are 36 – 45 years, and 20 respondents representing 16.3% are above 46 – 55 years. This implies that there was a good distribution of age among the target respondents in the oil and gas firms.

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Table 4: Educational Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	OND/HND	16	13.0	13.0	13.0
	Bachelor's Degree	41	33.3	33.3	46.3
	Master's Degree	27	22.0	22.0	68.3
	Doctorate Degree	13	10.6	10.6	78.9
	Professional Certification	26	21.1	21.1	100.0
	Total	123	100.0	100.0	

Table 4 shows the educational background of the respondents, 16 of the respondents representing 13.0% have OND/HND qualification, 41 of the respondents representing 33.3% have bachelor's degree qualification, 27 of the respondents representing 22.0% have master's degree qualification, 13 of the respondents representing 10.6% have master's degree qualification and finally, 26 of the respondents representing 21.1% have Professional Certification. This implies that at least the respondents could understand the issues in the questionnaire concerning environmental cost disclosures and sustainability performance of listed oil and gas firms in Nigeria.

Table 5: Department and Job Function

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Finance/Accounting	19	15.4	15.4	15.4
	Environmental Management/HSE	38	30.9	30.9	46.3
	Sustainability/CSR	12	9.8	9.8	56.1
	Operations/production	40	32.5	32.5	88.6
	General Management	14	11.4	11.4	100.0
	Total	123	100.0	100.0	

Results in table 5 disclosed the respondents' department and job function in the listed oil and gas firms. However, 15 respondents representing 15.4% belong to finance/accounting, 38 respondents representing 30.9% belong to environmental management/HSE, 12 respondents representing 9.8% belong to Sustainability/CSR, 40 respondents representing 32.5% belong to operations/production, 14 respondents representing 11.4% belong to operations/production,

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Table 6:   Position in the Organization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Officer/staff	26	21.1	21.1	21.1
	Supervisor	20	16.3	16.3	37.4
	Manager	36	29.3	29.3	66.7
	Executive/Director	30	24.4	24.4	91.1
	Consultant/Advisor	11	8.9	8.9	100.0
	Total	123	100.0	100.0	

Results in table 6 disclosed the respondents' position in the organization of the listed oil and gas firms. However, 26 respondents representing 21.1% employed as Officer/staff, 20 respondents representing 16.3% employed as supervisors, 36 respondents representing 29.3% employed as manager, 30 respondents representing 24.4% employed as executive/director and finally, 11 respondents representing 8.9% employed as executive/director.

Table 7: Years of Service

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	12	9.8	9.8	9.8
	1 – 5 years	21	17.1	17.1	26.8
	6 – 10 years	35	28.5	28.5	55.3
	11 – 15 years	35	28.5	28.5	83.7
	Over 15 years	20	16.3	16.3	100.0
	Total	123	100.0	100.0	

Results in table 7 disclosed the respondents' years of service in the listed oil and gas firms. However, 12 respondents representing 9.8% had worked for less than 1 year, 21 respondents representing 17.1% had worked for 1 – 5 years, 35 respondents representing 28.5% had worked for 6 – 10 years/ Also, 35 respondents representing 28.5% had worked for 11 – 15 years and finally, 20 respondents representing 16.3% had worked for Over 15 years.

Table 8: Organization Size

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Small (1 – 49 employees	15	12.2	12.2	12.2
	medium (50 – 199 employees	60	48.8	48.8	61.0
	large (200+ employees	48	39.0	39.0	100.0
	Total	123	100.0	100.0	

Results in table 8 disclosed the respondents' organization size in the listed oil and gas firms. However, 15 respondents representing 12.2% had small size (1 – 49 employees, 60 respondents representing 48.8% had medium size (50 – 199 employees and finally, 48 respondents representing 39.0% had large size (200+ employees.

Table 9: Does your organization publish environmental cost information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	100	81.3	81.3	81.3
	No	8	6.5	6.5	87.8
	Not sure	15	12.2	12.2	100.0
	Total	123	100.0	100.0	

Results in table 9 disclosed the organization information about publication of environmental costs in the listed oil and gas firms. However, 100 respondents representing 81.3% stated yes that their organization published environmental cost information, 8 respondents representing 6.5% stated No that their organization did not publish environmental cost information and finally, 15 respondents representing 12.2% stated not sure that their organization publish environmental cost information.

Table 10: Does your organization produce a sustainability or ESG report

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes (Annually)	79	64.2	64.2	64.2
	Yes (Occasionally)	34	27.6	27.6	91.9
	No	4	3.3	3.3	95.1
	Not Sure	6	4.9	4.9	100.0
	Total	123	100.0	100.0	

Results in table 10 disclose the organization information about producing a sustainability or ESG report in the listed oil and gas firms. However, 79 respondents representing 64.2% stated yes that their organization produce a sustainability or ESG report annually, 34 respondents representing 27.6% stated yes that their organization produce a sustainability or ESG report occasionally, 4 respondents representing 3.3% stated No that their organization did not produce a sustainability or ESG report and finally, 6 respondents representing 4.9% stated not sure that whether their organization produce a sustainability or ESG report.

Table 11: Do you participate in or influence sustainability-related decisions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes (directly involved)	47	38.2	38.2	38.2
	Yes (indirectly involved)	60	48.8	48.8	87.0
	No	16	13.0	13.0	100.0
	Total	123	100.0	100.0	

Results in table 11 disclosed the organization information about participating in or influencing sustainability-related decisions in the listed oil and gas firms. However, 47 respondents representing 38.2% stated yes that their organization participates in or influences sustainability-related decisions directly involved, 60 respondents representing 48.8% stated yes that their organization participates in or influences sustainability-related decisions indirectly involved, 16 respondents representing 13.0% stated No that their organization did not participate in or influence sustainability-related decisions.

Table 12: Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
CRC	123	4.00	1.00	5.00	3.3333	.14171	1.57161	2.470
PAC	123	4.00	1.00	5.00	3.3984	.13450	1.49172	2.225
RCC	123	4.00	1.00	5.00	3.3496	.13061	1.44848	2.098
RRC	123	4.00	1.00	5.00	3.2683	.13116	1.45463	2.116
SOP	123	4.00	1.00	5.00	3.0000	.12541	1.39084	1.934
ECP	123	4.00	1.00	5.00	3.3984	.12946	1.43573	2.061
GRN	123	4.00	1.00	5.00	2.9350	.14080	1.56152	2.438
Valid N (listwise)	123							

Source: Field Survey (2025)   **3.240429**   **1.479219**

The results in table 12 depicted the descriptive statistics of the Range, Minimum, Maximum Mean, Standard Deviation and Variance of responses on environmental cost disclosures dimension (CRC= Compliance and Regulatory Cost, PAC =Pollution and Abatement Cost, RCC = Resource Use and Conservation Cost, RRC =Remediation and Restoration Cost) and sustainability performance measures (SOP = Social Performance and ECP = Economic Performance) as well as the moderator (GRN = Green Innovation) of listed oil and gas firms in Nigeria using five questionnaire items that were designed on a five point Likert scale. Thus, all the variables Mean are above the cut-off point of **2.5**. However, the grand mean and standard deviation responses on the questionnaire items are disclosed (M=**3.240429**; SD=**1.479219**) respectively. This implied that an environmental cost disclosure is a significant predictor of sustainability performance of listed oil and gas companies in Nigeria. Also, green innovation has moderating effect on the relationship between environmental cost disclosures and sustainability performance of listed oil and gas firms in Nigeria.

Regression Analysis

Table 13a   Model One Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.783[a]	.613	.599	.34522

a. Predictors: (Constant), RRC, CRC, PAC, RCC

The model summary table produced a correlation coefficient; R = 0.783 showed that there is a strong correlation between prompt dependent measures of social performance (SOP) and independents measures of compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC). Our R^2 stood at 0.613 which implies that about 61.3% of variations in the dependent variable (prompt social performance) were attributed to changes in the independent variables of compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC). The remaining variation is the error term and is attributed to other factors not included in the model. The remaining value for social performance (SOP) in terms of sustainability performance is low since the unexplained variation is 38.7%.

Table 13b   Model One ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.230	4	5.557	46.631	.000[b]
	Residual	14.063	118	.119		
	Total	36.293	122			

a. Dependent Variable: SOP

b. Predictors: (Constant), RRC, CRC, PAC, RCC

The table above indicated a regression significant P-value of 0.000<0.05 and F(46.631) indicating that the overall model is statistically significant at 0.05 between the dependent variable of social performance (SOP) and the independent variables of compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC).

Table 13c Model One Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	4.264	.365		11.672	.000
	CRC	-.016	.034	-.045	-.456	.649
	PAC	-.258	.086	-.234	-2.992	.003
	RCC	.207	.042	.502	4.951	.000
	RRC	.055	.027	.161	2.031	.044

a. Dependent Variable: SOP

Test of Hypotheses Under Model One
Decision: Reject the null hypotheses; probability value is less than 5% significant level. Otherwise, accept the alternate hypotheses

Decision 1:
Table 13c disclosed the coefficient and t-Statistics of the estimated marginal effect of compliance and regulatory cost (CRC) on social performance (SOP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of compliance and regulatory cost (CRC) and social performance (SOP) was -0.016 and -0.456, indicating that compliance and regulatory cost (CRC) negatively affect social performance (SOP) of listed oil and gas firms in Nigeria. This negative effect is insignificant since the absolute value of P-value (0.649) was greater than 0.05. This simply disclosed that the null hypothesis (H_{01}) is accepted, and the alternate hypothesis (H_{a1}) was rejected. Therefore, it was concluded that compliance and regulatory cost disclosure has no significant effect on the social performance of listed oil and gas firms in Nigeria.

Decision 2:
Table 13c disclosed the coefficient and t-Statistics of the estimated marginal effect of pollution and abatement cost (PAC) on social performance (SOP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of pollution and abatement cost (PAC) and social performance (SOP) was -0.258 and -2.992, indicating that pollution and abatement cost (PAC) negatively affects social performance (SOP) of listed oil and gas firms in Nigeria. This negative effect is significant since the absolute value of P-value (0.003) was less than 0.05. This simply disclosed that the null hypothesis (H_{02}) is rejected, and the alternate hypothesis (H_{a2}) was accepted. Therefore, it was

concluded that pollution control and abatement cost disclosure has significant effect on the social performance of listed oil and gas firms in Nigeria.

Decision 3:
Table 13c disclosed the coefficient and t-Statistics of the estimated marginal effect of resource use and conservation cost (RCC) on social performance (SOP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of resource use and conservation cost (RCC) and social performance (SOP) was 0.207 and 4.951, indicating that resource use and conservation cost (RCC) positively affects social performance (SOP) of listed oil and gas firms in Nigeria. This positive effect is significant since the absolute value of P-value (0.000) was less than 0.05. This simply disclosed that the null hypothesis (**H03)** is rejected, and the alternate hypothesis (**Ha3)** was accepted. Therefore, it was concluded that resource use and conservation cost disclosure has significant effect on the social performance of listed oil and gas firms in Nigeria.

Decision 4:
Table 13c disclosed the coefficient and t-Statistics of the estimated marginal effect of remediation and restoration cost (RRC) on social performance (SOP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of remediation and restoration cost (RRC) and social performance (SOP) was 0.055 and 2.031, indicating that remediation and restoration cost (RRC) positively affects social performance (SOP) of listed oil and gas firms in Nigeria. This positive effect is significant since the absolute value of P-value (0.044) was less than 0.05. This simply disclosed that the null hypothesis (**H04)** is rejected, and the alternate hypothesis (**Ha4)** was accepted. Therefore, it was concluded that remediation and restoration cost has significant effect on the social performance of listed oil and gas firms in Nigeria.

Table 14a   Model Two Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.848[a]	.720	.710	.59687

a. Predictors: (Constant), RRC, CRC, PAC, RCC

The above model summary table produced a correlation coefficient; R = 0.848 showed that there is a strong correlation between prompt dependent measures of economic performance (ECP) and independents measures of compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC). Our R2 stood at 0.720 which implies that about 72.0% of variations in the dependent variable (prompt social performance) attributed to changes in the independent variables of compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC). The remaining variation is the error term and is attributed to other factors not included in the model. The remaining value for economic performance (ECP) in terms of sustainability performance is low since the unexplained variation is 27.8%.

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Table 14b   Model Two ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	107.930	4	26.982	75.739	.000[b]
	Residual	42.038	118	.356		
	Total	149.967	122			

a. Dependent Variable: ECP
b. Predictors: (Constant), RRC, CRC, PAC, RCC

The 14.b table indicates a regression significant P-value of 0.000<0.05 and F(75.739) indicating that the overall model is statistically significant at 0.05 between the dependent variable of economic performance (ECP) and the independent variables of compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC).

Table 14c   Model Two Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.215	.632		-.340	.735
	CRC	-.126	.059	-.179	-2.140	.034
	PAC	.423	.149	.189	2.839	.005
	RCC	.695	.072	.829	9.618	.000
	RRC	-.215	.047	-.308	-4.563	.000

a. Dependent Variable: ECP

Test of Hypotheses Under Model Two
Decision: Reject the null hypotheses; probability value is less than 5% significant level. Otherwise, accept the alternate hypotheses

Decision 5:
Table 14c disclosed the coefficient and t-Statistics of the estimated marginal effect of compliance and regulatory cost (CRC) on economic performance (ECP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of compliance and regulatory cost (CRC) and economic performance (ECP) was -0.126 and -2.140, indicating that compliance and regulatory cost (CRC) negatively affect economic performance (ECP) of listed oil and gas firms in Nigeria. This negative effect is significant since the absolute value of P-value (0.034) was less than 0.05. This simply disclosed that the null hypothesis (**H05**) is rejected, and the alternate hypothesis (**Ha5**) was accepted. Therefore, it was concluded that compliance and regulatory cost disclosure has significant effect on the economic performance of listed oil and gas firms in Nigeria.

Decision 6:
Table 14c disclosed the coefficient and t-Statistics of the estimated marginal effect of pollution and abatement cost (PAC) on economic performance (ECP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of pollution and abatement cost (PAC) and economic performance (ECP) was 0.423 and 2.839, indicating that pollution and abatement cost (PAC) positively affects economic performance (ECP) of listed oil and gas firms in Nigeria. This positive effect is significant since the absolute value of P-value (0.005) was less than 0.05. This simply disclosed that the null hypothesis (**H06**) is rejected, and the alternate hypothesis (**Ha6**) was accepted. Therefore, it was concluded that pollution control and abatement cost disclosure has significant effect on the economic performance of listed oil and gas firms in Nigeria.

Decision 7:
Table 13c disclosed the coefficient and t-Statistics of the estimated marginal effect of resource use and conservation cost (RCC) on economic performance (ECP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of resource use and conservation cost (RCC) and economic performance (ECP) was 0.695 and 9.618, indicating that resource use and conservation cost (RCC) positively affects economic performance (ECP) of listed oil and gas firms in Nigeria. This positive effect is significant since the absolute value of P-value (0.000) was less than 0.05. This simply disclosed that the null hypothesis (**H07**) is rejected, and the alternate hypothesis (**Ha7**) was accepted. Therefore, it was concluded that resource use and conservation cost disclosure has significant effect on the economic performance of listed oil and gas firms in Nigeria.

Decision 8:
Table 14c disclosed the coefficient and t-Statistics of the estimated marginal effect of remediation and restoration cost (RRC) on economic performance (ECP) of listed oil and gas firms in Nigeria. The coefficient and t-statistics of remediation and restoration cost (RRC) and economic performance (ECP) was -0.215 and -4.563, indicating that remediation and restoration cost (RRC) negatively affects economic performance (ECP) of listed oil and gas firms in Nigeria. This negative effect is significant since the absolute value of P-value (0.000) was less than 0.05. This simply disclosed that the null hypothesis (**H08**) is rejected, and the alternate hypothesis (**Ha8**) was accepted. Therefore, it was concluded that remediation and restoration cost has significant effect on the economic performance of listed oil and gas firms in Nigeria.

Table 15a: Model Summary^c Moderation Analysis of GRN in SOP Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.783^a	.613	.599	.34522	.613	46.631	4	118	.000
2	.870^b	.756	.739	.27868	.143	16.768	4	114	.000

a. Predictors: (Constant), RRC, CRC, PAC, RCC

b. Predictors: (Constant), RRC, CRC, PAC, RCC, INTRCC*GRN, INTRRC*GRN, INTPAC*GRN, INTCRC*GRN

Table 15a provides information on the unmoderated and moderated results obtained from social performance (SOP) model. The unmoderated and moderated R^2 for the social performance (SOP) specifications are 0.613 and 0.756 respectively that accounted for 61.3% and 75.6% of the variations in social performance (SOP) while 38.7% and 26.1% was explained by unknown variables that were not included in the Moderated Multiple Regression model in social performance (SOP). However, for purposes of testing the set of hypotheses on the change of statistics and other valuable information resulting from the interaction effect of relevance of financial information. The unmoderated and moderated R^2 for social performance (SOP) model are 0.613 and 0.756 respectively resulting to R^2 change of 0.143 (0.739- 0.613). This indicated an increase of 14.3% in the variation explained by the addition of the interaction term in the social performance (SOP) model

Table 15b   Summary of Moderation Analysis of GRN in SOP Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.520	4	10.130	54.902	.000[b]
	Residual	21.772	118	.185		
	Total	62.293	122			
2	Regression	40.665	7	5.809	30.890	.000[c]
	Residual	21.628	115	.188		
	Total	62.293	122			

a. Dependent Variable: SOP
b. Predictors: (Constant), RRC, CRC, RCC, PAC
c. Predictors: (Constant), RRC, CRC, RCC, PAC, INTRCC*GRN, INTRRC*GRN, INTPAC*GRN, INTCRC*GRN

Table 15b provides information on the unmoderated and moderate results obtained from social performance (SOP) model. The model has F-statistic values 54.902 and 30.890 in its unmoderated and moderated specifications with respective Prob. ** value 0.000[b] and 0.000[c] indicated that both the unmoderated and the moderated models are properly fitted since the Prob. ** value is less than the decision criterion of 5%.

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Table 15c Coefficients of Moderation Analysis of GRN in SOP Model

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.165	.049		3.367	.001
	CRC	-.016	.034	-.045	-.456	.649
	PAC	-.258	.086	-.234	-2.992	.003
	RCC	.207	.042	.502	4.951	.000
	RRC	.055	.027	.161	2.031	.044
2	(Constant)	-.036	.060		-.597	.551
	CRC	.297	.090	.293	3.283	.001
	PAC	.943	.064	.943	14.662	.000
	RCC	.354	.091	.352	3.908	.000
	RRC	-.437	.087	-.426	-5.008	.000
	INTCRC*GRN	-.136	.045	-.708	-3.034	.003
	INTPAC*GRN	-.115	.036	-.579	-3.153	.002
	INTRCC*GRN	.076	.034	.389	2.229	.026
	INTRRC*GRN	.142	.038	.735	3.706	.000

a. Dependent Variable: SOP

Test of Hypotheses Under Model Three
Decision: Reject the null hypotheses; probability value is less than 5% significant level. Otherwise; accepted the alternate hypotheses

Statement of Hypotheses
Green innovation does not significantly moderate the relationship between environmental cost disclosures and social performance of listed oil and gas firms in Nigeria.

Based on the results of the significant value from the above table 15c, it was disclosed that all of the dimensions of the independent variables (environmental cost disclosures) compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC) and remediation and restoration cost (RRC) have significant effect on social performance (SOP) since their sig values are less than 0.05 significant (0.001; 0.000; 0.000; 0.000 for stepwise 1 and 0.003; 0.002; 0.026; and 0.000 for stepwise 2). Also, based on the overall significant value of 0.000 in table 15a which is lesser than 0.05 significant level, the study rejected the null hypothesis (**H09**) and concluded that green innovation does significantly moderate the relationship between environmental cost disclosures and social performance of listed oil and gas firms in Nigeria.

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Table 16a: Model Summary Moderation Analysis of GRN in ECP Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.920[a]	.846	.844	.57847	.846	458.561	4	118	.000
2	.948[b]	.900	.897	.46944	.054	44.424	4	114	.000

a. Predictors: (Constant), RRC, CRC, PAC, RCC
b. Predictors: (Constant), RRC, CRC, PAC, RCC, INTRCC*GRN, INTRRC*GRN, INTPAC*GRN, INTCRC*GRN

Table 15a provides information on the unmoderated and moderated results obtained from social performance (SOP) model. The unmoderated and moderated R^2 for the economic performance (ECP) specifications are 0.948 and 0.900 respectively, that accounted for 94.8% and 90.0% of the variations in economic performance (ECP) while 5.2% and 10.0% were explained by unknown variables that were not included in the Moderated Multiple Regression model in economic performance (ECP). However, for purposes of testing the set of hypotheses on the change of statistics and other valuable information resulting from the interaction effect of relevance of financial information. The unmoderated and moderated R^2 for economic performance (ECP) model are 0.948 and 0.900 respectively resulting in R^2 change of 0.054 (0.948 - 0.900). This indicated an increase of 0.04% in the variation explained by the addition of the interaction term in the economic performance (ECP) model.

Table 16b   Summary of Moderation Analysis of GRN in ECP Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.282	4	10.070	53.988	.000[b]
	Residual	22.011	118	.187		
	Total	62.293	122			
2	Regression	40.479	7	5.783	30.486	.000[c]
	Residual	21.814	115	.190		
	Total	62.293	122			

a. Dependent Variable: ECP
b. Predictors: (Constant), RRC, CRC, RCC, PAC
c. Predictors: (Constant), RRC, CRC, RCC, PAC, INTRCC*GRN, INTRRC*GRN, INTPAC*GRN, INTCRC*GRN

Table 15b provides information on the unmoderated and moderated results obtained from economic performance (ECP) model. The model has F-statistic values 53.988 and 30.486 in its unmoderated and moderated specifications with respective Prob. ** value 0.000[b] and 0.000[c]

indicated that both the unmoderated and the moderated models are properly fitted since the Prob. ** value is less than the decision criterion of 5%.

Table 16c Coefficients of Moderation Analysis of GRN in ECP Model

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.165	.049		3.367	.001
	CRC	-.126	.059	-.179	-2.140	.034
	PAC	.423	.149	.189	2.839	.005
	RCC	.695	.072	.829	9.618	.000
	RRC	-.215	.047	-.308	-4.563	.000
2	(Constant)	-.036	.060		-.597	.551
	CRC	-.696	.119	-.653	-5.869	.000
	PAC	.235	.084	.224	2.788	.006
	RCC	1.328	.119	1.255	11.172	.000
	RRC	.174	.115	.161	1.520	.129
	INTCRC*GRN	.505	.059	2.494	8.569	.000
	INTPAC*GRN	-.249	.048	-1.195	-5.212	.000
	INTRCC*GRN	-.239	.045	-1.161	-5.336	.000
	INTRRC*GRN	-.024	.050	-.118	-.476	.635

a. Dependent Variable: ECP

Test of Hypotheses Under Model Three
Decision: Reject the null hypotheses; probability value is less than 5% significant level. Otherwise, accepted the alternate hypotheses

Statement of Hypotheses
Green innovation does not significantly moderate the relationship between environmental cost disclosures and economic performance of listed oil and gas firms in Nigeria. Based on the results of the significant value from the above table 16c, it was disclosed that three of dimensions of the independent variables (environmental cost disclosures) compliance and regulatory cost (CRC), pollution and abatement cost (PAC), resource use and conservation cost (RCC), have significant effect on economic performance (ECP) since their sig values is less than 0.05 significant (0.000; 0.006; 0.000; for stepwise 1 and 0.000; 0.000; 0.000 for stepwise 2) while remediation and restoration cost (RRC) have insignificant effect on economic performance (ECP) since it sig values is greater than 0.05 significant (0.129 for stepwise 1 and 0.635 for stepwise 2). However, based on the overall significant value of 0.000 in table 16a which is lesser than 0.05 significant level. The study rejected the null hypothesis (**H010**) and concluded that green innovation does significantly moderate the relationship between environmental cost disclosures and economic performance of listed oil and gas firms in Nigeria.

CONCLUSION, POLICY IMPLICATIONS, LIMITATIONS AND FURTHER RESEARCH

This study explored how green innovation moderates the link between environmental cost disclosures and sustainability performance of oil and gas firms in Nigeria. The findings reveal that compliance and regulatory cost disclosure has no significant effect on the social performance, that pollution control and abatement cost disclosure has significant effect on the social performance, resource use and conservation cost disclosure has significant effect on the social performance and remediation and restoration cost has significant effect on the social performance of listed oil and gas firms in Nigeria. Also, the findings disclose that compliance and regulatory cost disclosure has significant effect on economic performance, pollution control and abatement cost disclosure has significant effect on economic performance, resource use and conservation cost disclosure has significant effect on the economic performance and remediation and restoration cost has significant effect on economic performance of listed oil and gas firms in Nigeria. In essence, firms that transparently report their environmental costs and simultaneously invest in innovative, eco-friendly technologies and processes achieve higher levels of environmental, social, and economic sustainability. The findings of the moderating influence of green innovation reveals that green innovation does significantly moderate the relationship between environmental cost disclosures on social and economic performance of listed oil and gas firms in Nigeria. Hence green innovation enhances resource efficiency, reduces environmental degradation, and demonstrates proactive corporate responsibility thus reinforcing the credibility and effectiveness of environmental disclosure. Therefore, oil and gas firms in Nigeria should not only comply with environmental reporting requirements but also embed innovation into their operational and strategic frameworks. In conclusion, the study underscores that green innovation acts as a strategic enabler, strengthening the link between environmental accountability and sustainable performance.

The positive and significant link of the moderating influence of green innovation on the association between environmental cost disclosures and sustainability performance of oil and gas firms in Nigeria carries several vital implications for government agencies, regulatory bodies, industry stakeholders and management. First, regulatory bodies such as the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and the Federal Ministry of Environment should mandate comprehensive cost disclosure standards for oil and gas firms. Clear reporting frameworks that align with international standards such as the Global Reporting Initiatives (GRI) will enhance transparency and accountability in environmental management. Second, the government should introduce fiscal incentives, tax reliefs, or grants for firms that adopt green technologies and sustainable innovation. These incentives will encourage firms to move beyond compliance-based disclosure toward proactive environmental performance improvement. Third, policymakers should align environmental policies with innovation and industrial development policies. Establishing partnerships between government agencies, research institutions, and private firms can promote the development and diffusion of green technologies tailored to Nigeria's oil and gas sector. Fourth, there is need for continuous capacity development programs that train industry professionals on sustainability reporting, environmental accounting, and green technology adoption. Government agencies and professional bodies such as ICAN and ANAN can collaborate to build such capacity. Fifth, as Nigeria advances its energy Transition Plan (ETP) and net-zero

targets, policymakers should embed green innovation strategies within the oil and gas industry's sustainability framework to ensure a gradual yet effective shift toward low-carbon operations. Sixth, managers of oil and gas firms should view green innovation not merely as a compliance requirement but as a strategic investment that enhances long-term sustainability performance. Integrating eco-innovation into corporate strategies can improve operational efficiency, reduce waste, and strengthen the firm's competitive position.

While this study provides valuable considerations into the moderating influence of green innovation on link between environmental costs disclosures and sustainability performance of oil and gas firms in Nigeria, several limitations should be acknowledged, which also create opportunities for future research. First, the study focused exclusively on oil and gas firms in Nigeria, a sector that is highly regulated and environmentally sensitive. As a result, the findings may not be fully generalizable to other industries with different environmental or operational dynamics. Future research could extend the analysis to other sectors such as mining, energy, or manufacturing to enhance generalizability. Second, the study employed cross-sectional research design, which captures associations at a single point in time. This limits the ability to infer causality between environmental cost disclosures, green innovation, and sustainability performance. Future research should consider longitudinal or panel data approaches to observe how these links evolve over time. Third, the accuracy and completeness of data were constrained by the limited availability and inconsistencies of environmental disclosure information in corporate reports. Since many firms do not follow uniform reporting standards, future researchers could adopt content analysis framework or structured disclosure indices to improve data comparability and reliability. Fourth, green innovation was measured using questionnaire that may not fully capture the depth, quality, or novelty of innovation activities. Future research should consider qualitative assessments or case study methods to better understand how specific green innovations influence sustainability outcomes. Fifth, the study's context of Nigeria has unique regulatory, economic, and environmental conditions that may influence corporate behaviour differently from other regions. Future studies could undertake cross-country comparative analyses to explore how institutional factors and governance's systems shape the moderating role of green innovation.

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