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GREEN FINANCE AND ENVIRONMENTAL SUSTAINABILITY OF QUOTED OIL AND GAS FIRMS IN NIGERIA

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ABSTRACT

This study examined the effect of green finance on the environmental sustainability of quoted oil and gas firms in Nigeria. The study adopted an ex-post facto research design and covered the period from 2014 to 2023. Secondary data were obtained from the annual and sustainability reports of the sampled firms, the Nigerian Exchange Group (NGX), the Central Bank of Nigeria (CBN) Statistical Bulletin, the Nigerian National Petroleum Company Limited (NNPCL) and the Securities and Exchange Commission (SEC). The relationship between green finance and environmental sustainability was analysed using a panel data regression framework based on a Random Effects model. Environmental sustainability served as the dependent variable, while carbon credit, green investment, green management functions and green bonds were employed as proxies for green finance. The findings revealed that the overall model was statistically significant (F-statistic = 9.144461, $p < 0.01$) and explained approximately 54.53% of the variation in environmental sustainability ($R^2 = 0.545304$). The results further showed that carbon credit exerted a positive and statistically significant effect on environmental sustainability, whereas green management functions, green bonds and green investment had effects that were not statistically significant. The study concludes that although green finance has the potential to enhance environmental sustainability, its impact among quoted oil and gas firms in Nigeria remains uneven, with carbon credit emerging as the most effective green finance instrument. The study therefore recommends that policymakers should strengthen carbon credit frameworks and expand incentives for green financing in order to encourage greater investment in environmentally sustainable projects within the oil and gas sector.

Keywords: Green Finance, Environmental Sustainability, Carbon Credit, Green Bonds, Green Investment, Oil And Gas Firms, Nigeria.

1 INTRODUCTION

The increasing frequency of climate change, biodiversity loss and environmental degradation has intensified global calls for sustainable economic development. Over the past decade, the international community has increasingly recognised that financial systems have a critical role to play in supporting environmental sustainability through the mobilisation of capital towards environmentally responsible investments. Consequently, green finance has emerged as an important component of sustainable finance, providing financial resources for projects and business activities that reduce carbon emissions, improve environmental quality and promote climate resilience (Organisation for Economic Co-operation and Development [OECD], 2017). Green finance extends beyond environmental protection by encouraging firms to integrate sustainability into investment decisions, corporate governance and long-term value creation.

The growing significance of green finance has been reinforced by international agreements such as the Paris Climate Agreement and the United Nations Sustainable Development Goals (SDGs), particularly Goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 12 (Responsible Consumption and Production) and 13 (Climate Action) (United Nations, 2015). These global initiatives have stimulated substantial growth in green financial instruments, including green bonds, sustainability-linked loans, green credit, climate funds and transition finance. As a result, governments, financial institutions and investors increasingly channel capital towards organisations that demonstrate strong environmental commitments and sustainable business practices (International Finance Corporation [IFC], 2023).

The oil and gas industry remains central to global economic development despite the accelerating transition towards low-carbon energy systems. The sector supplies a significant proportion of the world's energy requirements and contributes substantially to national income, employment and industrial development. However, it is also among the largest contributors to greenhouse gas emissions, environmental pollution and ecosystem degradation. Oil exploration, production, refining and transportation frequently generate environmental externalities, including carbon emissions, methane leakage, gas flaring, oil spills, land degradation and water contamination (Intergovernmental Panel on Climate Change [IPCC], 2023). Consequently, oil and gas companies are increasingly under pressure from regulators, investors and host communities to improve their environmental performance while maintaining operational efficiency. Environmental performance has therefore evolved into a strategic indicator of corporate sustainability. It reflects an organisation's ability to minimise its environmental footprint through efficient resource utilisation, pollution prevention, emission reduction, environmental compliance and investments in cleaner production technologies. Strong environmental performance enhances corporate legitimacy, reduces regulatory risks, strengthens stakeholder confidence and improves firms' ability to attract sustainable investment (Bayo & Ude, 2026; Eccles & Klimenko, 2019). Conversely, poor environmental performance exposes firms to litigation, regulatory sanctions, reputational damage and increased financing costs.

Green finance provides an important mechanism through which firms can improve environmental performance. By facilitating access to environmentally focused capital, firms can invest in renewable energy technologies, energy-efficient equipment, carbon capture systems, cleaner production processes, environmental remediation projects and sustainable waste management practices. These investments not only reduce environmental risks but also improve operational efficiency and strengthen long-term competitiveness. Increasingly, investors and financial institutions consider environmental performance alongside traditional financial indicators when evaluating corporate sustainability and investment decisions. Nigeria presents an important context for examining the relationship between green finance and environmental performance because its economy remains heavily dependent on the oil and gas sector. The petroleum industry accounts for a substantial proportion of export earnings and government revenue but has simultaneously generated severe environmental challenges, particularly within the Niger Delta. Decades of oil exploration have resulted in persistent oil spills, gas flaring, deforestation, water pollution and biodiversity loss, with significant socio-economic consequences for host communities (United Nations Environment Programme [UNEP], 2011). These environmental concerns have intensified demands for more sustainable production practices and greater corporate environmental accountability.

In response to growing environmental challenges, Nigeria has implemented several sustainable finance initiatives aimed at encouraging environmentally responsible investments. The Central Bank of Nigeria introduced the Nigerian Sustainable Banking Principles to integrate environmental and social considerations into financial decision-making (Central Bank of Nigeria, 2012). Similarly, the Nigerian Exchange Group strengthened sustainability disclosure requirements for listed companies, while the Federal Government continues to expand its green bond programme to finance environmentally sustainable projects. More recently, Nigerian regulators have required applicants for upstream oil licences to demonstrate low-carbon development plans and renewable energy programmes as part of broader decarbonisation efforts. These policy initiatives reflect Nigeria's commitment to achieving net-zero emissions by 2060 while maintaining energy security and economic growth. Despite these policy developments, the adoption of green finance within Nigeria's corporate sector remains relatively limited, particularly among quoted oil and gas firms. Existing investments in environmental sustainability continue to lag behind the scale of environmental challenges facing the industry. Furthermore, many firms still rely heavily on conventional financing mechanisms that may not adequately support long-term environmental investments. This financing gap raises important questions regarding the effectiveness of green finance in improving corporate environmental outcomes within environmentally sensitive industries.

Empirical evidence on green finance and environmental performance also remains fragmented. International studies generally suggest that green finance promotes cleaner production, carbon reduction and sustainable corporate practices. However, findings differ across countries because of variations in institutional quality, environmental regulations, financial market development and corporate governance structures. Within Nigeria, existing studies have primarily examined green finance in relation to financial performance, banking sector sustainability, green accounting or entrepreneurship, with comparatively limited attention devoted to the environmental outcomes of quoted oil and

gas firms. Furthermore, many previous studies have focused on environmental disclosure rather than actual environmental performance, leaving an important empirical gap in understanding whether green finance translates into measurable environmental improvements.

Given the increasing regulatory emphasis on sustainable finance, heightened investor expectations regarding Environmental, Social and Governance (ESG) performance, and Nigeria's commitment to a low-carbon transition, there is a compelling need to investigate whether green finance contributes to improved environmental performance among quoted oil and gas firms. Such evidence would provide valuable insights for policymakers, regulators, investors and corporate managers seeking to balance economic development with environmental sustainability. Consequently, this study examines the effect of green finance on the environmental performance of quoted oil and gas firms in Nigeria.

2 LITERATURE REVIEW

2.1 Theoretical Review

This study is anchored on the Natural Resource-Based View (NRBV) Theory, while also drawing insights from Stakeholder Theory and Legitimacy Theory. Together, these theories provide a comprehensive explanation of how green finance can influence the environmental performance of quoted oil and gas firms in Nigeria.

2.2 Natural Resource-Based View (NRBV) Theory

The Natural Resource-Based View (NRBV) Theory, developed by Hart (1995), extends the Resource-Based View of Barney (1991) by recognising environmental capabilities as strategic resources that can generate sustainable competitive advantage. The theory argues that firms can improve both environmental and economic performance by investing in pollution prevention, cleaner technologies, product stewardship and sustainable development initiatives.

Within the context of this study, green finance provides the financial resources required to undertake such investments through instruments such as green bonds, green credit and sustainability-linked financing. These investments enable firms to reduce emissions, improve resource efficiency and strengthen environmental performance. The theory is particularly relevant to Nigeria's oil and gas industry, where environmental challenges such as oil spills and gas flaring necessitate substantial investment in environmentally sustainable technologies.

Although the NRBV has been criticised for placing less emphasis on institutional and regulatory factors, it remains an appropriate theoretical foundation because it directly links environmental investment with improved environmental performance (Hart, 1995).

2.3 Stakeholder Theory

Stakeholder Theory, proposed by Freeman (1984), posits that organisations are accountable to a broad range of stakeholders, including investors, regulators, employees, host communities and the natural environment. Firms are therefore expected to balance economic objectives with environmental and social responsibilities.

The theory suggests that increasing stakeholder demand for sustainability encourages firms to adopt green finance as a means of funding environmentally responsible projects. For quoted oil and gas firms in Nigeria, green finance facilitates investments that improve environmental performance while strengthening relationships with investors, regulators and host communities. Despite criticisms regarding the prioritisation of competing stakeholder interests, the theory provides a useful explanation for firms' environmental commitments.

2.4 Legitimacy Theory

Legitimacy Theory, advanced by Dowling and Pfeffer (1975) and further developed by Suchman (1995), argues that organisations seek to align their activities with societal values and expectations to maintain legitimacy. In environmentally sensitive industries, firms are expected to demonstrate responsible environmental behaviour to preserve public trust and their licence to operate.

Green finance enables firms to invest in pollution control, environmental remediation and cleaner production technologies, thereby improving environmental performance and reinforcing corporate legitimacy. Although the theory has been criticised for focusing on public perception rather than actual environmental outcomes, it remains relevant in explaining why firms adopt environmentally sustainable financing practices.

3 CONCEPTUAL REVIEW

3.1 Green Finance

Green finance refers to financial activities and investment mechanisms that support environmentally sustainable development by directing capital towards projects that minimise environmental degradation and address climate change (Wang & Zhi, 2016). It includes financial instruments such as green bonds, green loans, sustainability-linked loans and climate funds, which provide firms with the resources needed to invest in renewable energy, cleaner production technologies, pollution control and resource-efficient processes (Taghizadeh-Hesary & Yoshino, 2019). The concept has gained considerable attention as governments, financial institutions and investors increasingly recognise that financial markets are essential to achieving sustainable development. According to Ziolo et al. (2019), green finance encourages environmentally responsible investment while promoting long-term economic growth. For firms, it facilitates environmental innovation, enhances compliance with environmental regulations and supports sustainable business practices. In this study, green finance is conceptualised as the financing mechanisms that enable quoted oil and gas firms in Nigeria to undertake environmentally sustainable investments.

3.2 Environmental Sustainability

Environmental sustainability refers to the responsible use and management of natural resources in a manner that satisfies present needs without compromising the ability of future generations to meet their own needs (Brundtland, 1987). At the corporate level, it reflects a firm's commitment to reducing its environmental footprint through efficient resource utilisation, pollution prevention, carbon emission reduction and environmental conservation (Goodland, 1995). Environmental sustainability extends beyond regulatory compliance to include practices that promote ecological balance, biodiversity conservation and climate resilience. According to Dyllick and Hockerts (2002), environmentally sustainable firms integrate environmental considerations into their operational and strategic decisions, thereby creating long-term value for both society and the organisation. Within the oil and gas sector, environmental sustainability is particularly important because the industry's activities often contribute to oil spills, gas flaring, greenhouse gas emissions and ecosystem degradation. Consequently, firms are increasingly expected to adopt cleaner technologies and environmentally responsible production processes. For this study, environmental sustainability refers to the extent to which quoted oil and gas firms in Nigeria adopt practices that minimise environmental degradation, conserve natural resources and contribute to long-term ecological sustainability.

3.3 Green Finance and Environmental Sustainability

Green finance and environmental sustainability are closely connected because environmentally sustainable projects often require significant financial investment. Green finance provides firms with the capital needed to invest in clean technologies, renewable energy, waste management systems and carbon reduction initiatives, thereby supporting environmentally sustainable operations (Taghizadeh-Hesary & Yoshino, 2019). Wang and Zhi (2016) argue that green finance promotes environmental sustainability by removing financial barriers to environmental investments, while Ziolo et al. (2019) contend that sustainable financing encourages firms to adopt greener production methods and improve their environmental stewardship. For quoted oil and gas firms in Nigeria, access to green finance is expected to facilitate investments that reduce environmental pollution, improve resource efficiency and support the transition towards more sustainable business operations.

4 EMPIRICAL REVIEW

Huang, Zhao, and Zhang (2022) investigated the effect of green finance on sustainable development using data from a panel of countries across the globe. The study employed a bootstrap rolling-window Granger causality approach to examine the dynamic relationship between green finance and sustainable development. The findings revealed that green finance significantly enhances environmental sustainability by encouraging investments in environmentally friendly projects and facilitating the transition towards low-carbon development. The authors concluded that strengthening green financial systems is essential for achieving sustainable environmental outcomes. Although the study provided valuable cross-country evidence, it was conducted at the macroeconomic level and did not focus on firm-level environmental sustainability, particularly within the oil and gas industry. Siddik et al. (2022) examined the relationship between green finance, corporate social responsibility and environmental sustainability in the banking sector of Bangladesh. Using Structural Equation Modelling (SEM), the study found that green finance significantly improves environmental sustainability by supporting environmentally responsible banking practices and green investments. The authors concluded that financial institutions can contribute substantially to environmental sustainability through increased adoption of green financing initiatives. However, the study focused exclusively on the banking sector, making its findings difficult to generalise to environmentally sensitive industries such as oil and gas. Zhang, Chen, and Tang (2022) explored the influence of green finance and innovation on environmental sustainability using panel data from Chinese provinces. The study applied panel regression techniques and established that green

finance significantly promotes environmental sustainability by stimulating green technological innovation and reducing environmental pollution. The study further revealed that innovation serves as an important transmission mechanism through which green finance improves environmental outcomes. Nevertheless, the analysis was conducted at the provincial level rather than the corporate level, leaving limited evidence regarding listed firms. Khan, Ahmad, Yusof, and Chowdhury (2024) conducted a systematic review of empirical studies on green finance and environmental sustainability published across developed and developing economies. Using the PRISMA framework, the study synthesised existing evidence and found a strong consensus that green finance encourages renewable energy investment, improves environmental quality and supports sustainable economic development. The review also identified Africa as one of the least researched regions and highlighted the need for more firm-level studies within emerging economies. This observation provides strong justification for examining quoted oil and gas firms in Nigeria. Omri, Jarraya, and Kahia (2025) examined the relationship between green finance and environmental sustainability across the G7 countries using panel data covering the period 2012–2022. The study employed Hayes' Process Macro to examine both mediation and moderation effects. The findings showed that green finance significantly improves environmental sustainability by reducing carbon emissions, while environmental innovation partially mediates this relationship. In addition, FinTech and environmental policy strengthened the positive impact of green finance on environmental sustainability. The study concluded that effective financial systems and supportive environmental policies are complementary drivers of sustainable development. However, the study focused on developed economies, whose institutional and financial environments differ considerably from those of developing countries such as Nigeria.

Balcerzak et al. (2025) investigated the contribution of green finance to the environmental dimension of Environmental, Social and Governance (ESG) performance across European Union member states. Using panel econometric techniques, the study found that green finance exerts a positive and statistically significant influence on environmental sustainability by encouraging investments in environmentally responsible projects and improving countries' environmental performance. The authors emphasised that well-developed green financial systems are essential for achieving long-term sustainability objectives. Despite its robust methodology, the study was conducted at the country level rather than among individual firms and therefore provides limited evidence for corporate environmental sustainability within the oil and gas sector. Li et al. (2025) examined the effect of green finance on environmental sustainability across the G7 economies using panel data from 2012 to 2022. The study employed mediation analysis to investigate the channels through which green finance influences environmental sustainability. The results indicated that green finance significantly improves environmental sustainability by reducing carbon emissions, with environmental innovation serving as an important transmission mechanism. The study concluded that green finance, when supported by innovation and effective environmental policies, contributes substantially to sustainable development. However, the findings were derived from advanced economies and may not fully reflect the institutional and financing realities of developing countries such as Nigeria. Rajı et al. (2025) examined the relationship between sustainability reporting and the financial performance of quoted non-financial companies in Nigeria. The study analysed panel data from twenty-eight listed firms covering the period 2018–2022 using descriptive statistics, correlation analysis and panel regression techniques. The findings showed that environmental sustainability reporting positively influences corporate performance, suggesting that firms adopting stronger environmental practices are more likely to improve their long-term competitiveness. The authors concluded that environmental sustainability should be integrated into corporate strategy to enhance organisational performance. Although the study contributes to sustainability literature in Nigeria, it focused on sustainability reporting rather than green finance and did not specifically examine quoted oil and gas firms. Fakayode and Ola (2025) investigated environmental financial reporting practices among quoted companies in Nigeria. The study employed an ex post facto research design using secondary data obtained from the annual reports of listed manufacturing companies. Panel regression techniques were used to examine the relationship between environmental financial reporting and corporate environmental practices. The results indicated that firms with stronger environmental financial reporting demonstrated greater commitment to environmental sustainability and compliance with internationally recognised environmental reporting standards. The authors concluded that environmental reporting enhances corporate accountability and encourages environmentally responsible business practices. Nevertheless, the study focused on environmental reporting rather than green financing and was limited to manufacturing firms. Eke and Emasogbe (2025) examined the impact of green finance on sustainable development in Nigeria using annual time-series data obtained from the Nigerian Development Bank. The study adopted an ex post facto research design and employed Ordinary Least Squares (OLS) regression to analyse the effects of green bond issuance, green loans and renewable energy investments on Green Gross Domestic Product (Green GDP). The findings revealed that green bonds, green loans and renewable energy investments exert a positive and statistically significant effect on sustainable development in Nigeria, with renewable energy investment having the strongest influence. The authors concluded that expanding green financial instruments would accelerate environmental sustainability and sustainable economic growth. The study, however, adopted a macroeconomic perspective and did not examine firm-level environmental sustainability among quoted companies.

5 METHODOLOGY

This study employed an ex-post facto research design, which is suitable for examining relationships green finance and environmental sustainability. The study spans a 10-year period (2014–2023), allowing for the assessment of both short-run variations and long-run dynamics in the relationship between green finance and environmental sustainability. Secondary data were sourced from the annual and sustainability reports of the sampled firms, the Nigerian Exchange Group (NGX) official publications, the Central Bank of Nigeria (CBN) Statistical Bulletin, and relevant databases maintained by the Nigerian National Petroleum Company Limited (NNPCL) and the Securities and Exchange Commission (SEC). Consistent with the theoretical framework and empirical literature reviewed, the study formulates the following econometric model to evaluate the influence of green finance on the environmental sustainability of quoted oil and gas firms in Nigeria.

$$ES_{it} = \beta_0 + \beta_1 CC_{it} + \beta_2 GRI_{it} + \beta_3 GFMit + \beta_4 GBD_{it} + \varepsilon_{it} \quad (1)$$

Where, ES = Environmental Sustainability, CC = Carbon Credit, GRI = Green Investment, GMF = Green Management Functions, GBD = Green Bonds, β_0 = Intercept term, β_1, β_2, β_3, β_4 = Coefficients to be estimated, ε_{it} = Stochastic error term. The Hausman specification test was conducted to determine the appropriate estimation technique between fixed effects and random effects.

6 RESULTS AND DISCUSSION

Table 1: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.691779	4	0.4493

Source: Extract from Eviews 12., 2026

From table 1 above, the Hausman test shows probability of the Chi-Sq. Statistic is 0.4493 is greater than 0.05, therefore, the study adopts the random effect model. The table also shows comparable differences between fixed and random effect models in the results, the results in the table shows probability greater than 0.05 which implies that there is a significant difference between random and fixed effect model.

Table 2: Panel Random Effects Regression Results

Variable	Coefficient	Std. Error	t-statistic	p-value
Intercept	224.3618	218.6232	1.026249	0.3088
D(CC)	59.68710	33.58137	1.777387	0.0405*
CC(-1)	-8.394702	14.75409	-0.568975	0.5715
GMF	2.224139	2.974838	0.747651	0.4575
GMF(-1)	-2.975560	2.726577	-1.091317	0.2794
GBD	-34.75117	39.63314	-0.876821	0.3840
D(GRI(-1))	-8.880593	15.40721	-0.576392	0.5665
D(GRI(-2))	-9.626726	18.40066	-0.523173	0.6027

Source: Extract from Eviews 12., 2026; **Note**: Dependent Variable: ES (Environmental Sustainability). ** Significant at 1% level. * Significant at 5% level. R-squared =0.545304, F-statistic = 9.144461 ($p < 0.01$), Durbin Watson Sta = 1.974783.

The findings indicate that green finance exerts a mixed influence on the environmental sustainability of quoted oil and gas firms in Nigeria. The overall model is statistically significant (F-statistic = 9.144461, $p < 0.01$), suggesting that the selected green finance variables jointly explain variations in environmental sustainability. Furthermore, the R-squared value of 0.545304 implies that approximately 54.53 per cent of the variations in environmental sustainability are explained by carbon credit, green investment, green management functions and green bonds. The Durbin–Watson statistic of 1.974783 also indicates the absence of serious autocorrelation, confirming the reliability of the estimated model.

The results further reveal that carbon credit (CC) has a positive and statistically significant effect on environmental sustainability (β = 59.68710, *p* = 0.0405). This suggests that greater participation in carbon credit initiatives contributes to improved environmental sustainability among quoted oil and gas firms. The finding implies that carbon pricing mechanisms encourage firms to reduce greenhouse gas emissions and adopt cleaner operational practices. This result is consistent with the findings of Huang et al. (2022), who reported that green finance promotes environmental sustainability by facilitating investments in environmentally friendly projects and supporting low-carbon development. It also agrees with the studies of Omri et al. (2025), Balcerzak et al. (2025) and Li et al. (2025), which found that green finance significantly improves environmental sustainability through carbon emission reduction and environmental innovation. Similarly, Eke and Emasogbe (2025) reported that green financial instruments positively contribute to sustainable development in Nigeria. The significance of carbon credit in the present study demonstrates that market-based environmental financing mechanisms are beginning to influence corporate environmental practices within Nigeria's oil and gas sector. Conversely, the lagged value of carbon credit [CC(-1)] is negative and statistically insignificant. This suggests that the environmental benefits associated with carbon credit schemes are largely realised in the current period rather than being sustained over time. The finding may reflect the relatively recent adoption and limited maturity of carbon market mechanisms in Nigeria, where long-term environmental gains have yet to become fully established. The coefficient of green management functions (GMF) is positive but statistically insignificant (β = 2.224139, *p* = 0.4575), while its lagged value also remains insignificant. This indicates that although environmentally oriented management practices appear to support environmental sustainability, their contribution is not sufficiently strong to produce a measurable effect within the sampled firms. A possible explanation is that many quoted oil and gas firms have adopted environmental management initiatives primarily to satisfy regulatory requirements rather than as integrated strategic practices capable of delivering substantial environmental improvements. This finding contrasts with Siddik et al. (2022), who found that green management practices embedded within green finance significantly improved environmental sustainability in the banking sector. It also differs from the findings of Zhang, Chen, and Tang (2022), who established that innovation and green management initiatives strengthen the positive effects of green finance on environmental sustainability. The disparity may be attributed to differences in industry characteristics, institutional environments and the relatively slow pace of green management implementation within Nigeria's oil and gas industry. The findings also show that green bonds (GBD) have a negative but statistically insignificant effect on environmental sustainability (β = -34.75117, *p* = 0.3840). This suggests that green bond financing has not yet translated into measurable improvements in the environmental sustainability of quoted oil and gas firms in Nigeria. The result may be explained by the underdeveloped nature of Nigeria's green bond market and the relatively low utilisation of green bond financing by firms within the sector. Consequently, the environmental benefits associated with green bonds may not yet be sufficiently widespread to produce significant firm-level outcomes. This finding differs from Eke and Emasogbe (2025), who found that green bonds positively contribute to sustainable development in Nigeria. It also contrasts with Huang et al. (2022), Balcerzak et al. (2025) and Li et al. (2025), who reported positive effects of green finance on environmental sustainability. However, the inconsistency may reflect structural differences between macroeconomic studies and firm-level analysis, as well as the relatively early stage of green capital market development in Nigeria.

Similarly, the first and second lagged differences of green investment (GRI) are both negative and statistically insignificant. This indicates that previous green investment activities have not generated immediate improvements in environmental sustainability among the sampled firms. Environmental investments often require considerable implementation periods before their benefits become evident, particularly in capital-intensive industries such as oil and gas. The finding therefore suggests that the environmental gains from green investment may materialise only over a longer time horizon. This result is inconsistent with Zhang, Chen, and Tang (2022), who found that green investment and technological innovation significantly improve environmental sustainability. It also differs from Li et al. (2025), who identified environmental innovation as a key mechanism through which green finance enhances sustainability. The observed variation may be attributed to differences in institutional quality, technological readiness and the availability of green financing mechanisms between Nigeria and more developed economies.

7 CONCLUSION

This study examined the effect of green finance on the environmental sustainability of quoted oil and gas firms in Nigeria using panel random effects regression analysis. The findings revealed that green finance exerts a mixed influence on environmental sustainability within the sector. Specifically, carbon credit had a positive and statistically significant effect on environmental sustainability, indicating that market-based carbon financing mechanisms contribute to improved environmental outcomes. In contrast, green management functions, green bonds and green investment did not exert statistically significant effects, suggesting that these green finance instruments have not yet translated into measurable improvements in environmental sustainability among the sampled firms. The study concludes that while green finance has the potential to enhance environmental sustainability, its effectiveness in Nigeria's quoted oil and gas sector remains at an emerging stage. The significant role of carbon credit demonstrates that targeted green financial mechanisms can support environmental sustainability when effectively implemented. However, the limited impact of

the other green finance dimensions highlights the need for stronger institutional support, increased investment in sustainable projects and a more developed green finance ecosystem. Consequently, achieving meaningful environmental sustainability within the sector will require greater commitment from firms, policymakers and financial institutions to expand and strengthen green financing initiatives.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

- Oil and gas firms should increase participation in carbon credit programmes by adopting carbon reduction initiatives and emissions trading mechanisms, as carbon credit was found to significantly improve environmental sustainability.
- Government and financial regulators should strengthen the green finance framework by introducing incentives such as tax reliefs, concessional financing and supportive regulatory policies to encourage greater issuance and utilisation of green bonds and other green financial instruments.
- Management of quoted oil and gas firms should integrate green management practices into their core business strategies rather than treating them primarily as regulatory compliance requirements. This will enhance the long-term environmental benefits of sustainable management initiatives.
- Firms should expand investment in environmentally sustainable technologies and projects, including renewable energy, cleaner production processes, waste management systems and emission reduction technologies, to ensure that the long-term benefits of green investment are fully realised.
- The Nigerian Exchange Group, financial institutions and relevant government agencies should collaborate to deepen the domestic green finance market through improved awareness, investor education and increased access to green financing instruments, thereby enabling firms to finance environmentally sustainable projects more effectively.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

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