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Environmental Accounting Costs and Financial Performance of Oil and Gas Companies in Nigeria: Interplay of Resource-Based-View, Stakeholder and Legitimacy Theories

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Abstract This study examines the impact of environmental accounting costs on the financial performance of listed oil and gas companies in Nigeria. High-risk industries like oil and gas face significant scrutiny with environmental sustainability now a global priority. In Nigeria, oil exploration in the Niger Delta has caused severe environmental damage, affecting the operational performance of oil companies. This research evaluates whether transparent reporting on environmental conservation and pollution remediation costs influences profitability and financial health. Grounded in Resource-Based View, Stakeholder, and Legitimacy Theories, the study explores how environmental costs can function as strategic assets, enhancing corporate reputation and stakeholder trust. Using a quantitative approach, the study analyzed data from ten (10) oil and gas firms listed on the Nigerian Exchange Limited (NGX) that spanned from 2013 to 2022 (10 years), yielding 400 observations. Data from annual reports were subjected to regression analysis, with robustness checks confirming the results' reliability. The findings show a positive relationship between environmental costs and financial performance, suggesting that companies that sign environmental agreements will be more profitable. This supports the view that companies seen as environmentally responsible attract investors and customers, gaining a competitive edge. The study concludes that environmental costs are not merely regulatory requirements but can be strategic tools for long-term financial success. It provides empirical evidence from a developing-country context, addressing a gap in the sector. Practically, the study encourages firms to incorporate environmental practices into their strategies. Socially, it underscores the role of corporate responsibility in promoting sustainable development. Limitations include its focus on a single industry and region; future research could explore cross-industry comparisons and broader geographical contexts.

Keywords Environmental Accounting Costs, Financial Performance, Stakeholder, Legitimacy, Oil and Gas Companies

1. Introduction

The business environment includes various factors such as cultural, political, social, technological, economic, environmental, and regulatory elements, which considerably impact business stability, growth, and performance, particularly earnings. Inherently connected to their environment, businesses depend on it for resources

and are responsible for waste management [1,2]. Despite this, industrial firms have historically neglected their environmental responsibilities, especially in regions like Nigeria [3].

The drive for growth and shareholder value often overshadows environmental concerns in corporate financial reports. The Industrial Revolution marked the beginning of extensive natural resource exploitation, leading to significant ecological degradation [1]. This has prompted the development of global regulatory frameworks to encourage sustainable practices, though adoption remains voluntary. Organizations like the Sustainability Accounting Standards Board (SASB), GRI, and the International Integrated Reporting Council (IIRC), have created guidelines to support environmental disclosure, which can offer strategic advantages to compliant firms [4].

As stakeholder demands for transparency grow, firms face increasing pressure to report on their environmental impacts. Focusing on financial performance alone is now considered outdated, as stakeholders increasingly consider a firm's relationship with its environment. Environmental reporting is seen as a marker of corporate responsibility, potentially leading to better performance and community relations. However, opponents argue that mandatory environmental reporting may not enhance financial performance and could be costly.

Financial performance is a vital indicator of a firm's sustainability, showcasing its ability to efficiently utilize resources to enhance profitability and shareholder value. It is influenced by various factors, including the business environment. Researchers have examined the link between environmental and financial performance, particularly in environmentally sensitive sectors like manufacturing. While developed nations have advanced in environmental reporting, developing countries face challenges, often due to weaker regulatory frameworks.

Although extensive studies on environmental accounting costs exist in developed economies, developing nations have been slower to adopt corporate social and environmental responsibility practices [6]. This delay is frequently linked to inadequate regulatory enforcement. Despite a plethora of studies [7–12] offering mixed results, research focusing on environmental disclosure in the manufacturing sector of developing economies remains scarce. Even fewer studies address the oil and gas industry in these regions.

In Nigeria, the Niger Delta region has suffered severe environmental damage due to oil exploration, affecting the operational performance of oil companies. Therefore, this study examines the effect of ecological accounting disclosure on the financial performance of oil and gas companies in Nigeria.

The remainder of this study is structured as follows: Section 2 presents the literature review and hypotheses development. Section 3 describes the research methodology, and Section 4 provides data analysis. Finally, Section 5 concludes the study.

2. Literature Review and Hypotheses Development

In this section of the study, the conceptual framework, theoretical framework, and empirical review are carried out for a clear understanding of the paper.

2.1. Conceptual Framework

The conceptual framework diagram (Figure 1) shows the relationship between the independent variables (Environmental Conservation Costs and Environmental Pollution Remediation Costs) and the dependent variables (Return on Assets and Net Profit Margin), as well as the theoretical underpinnings.

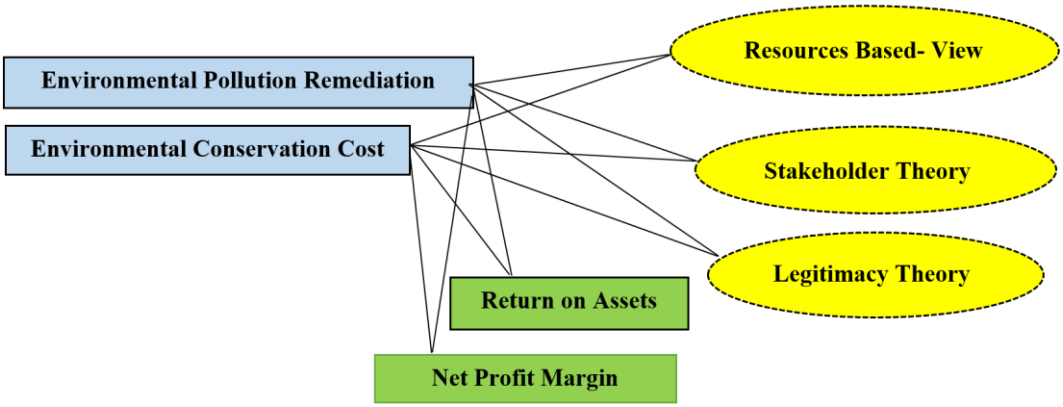

Figure 1. Conceptual Framework of Environmental Accounting Costs and Financial Performance: Interplay of Resource-Based View, Stakeholder and Legitimacy Theories

2.1.1. Environmental Accounting Costs

Sustainability reports cover a broader scope than environmental reports, though environmental reporting is often considered a part of sustainability reporting. Terms like sustainability reports, corporate social and environmental disclosure, and corporate environmental reports are frequently used interchangeably in research. Regardless of the terminology, a sustainability report is a formal document that details an organization's economic, environmental, and social impacts [13]. Garg [14] defines sustainability reports as voluntary disclosures that provide stakeholders with information about how a company's activities influence society and the environment. These reports also demonstrate how a company's strategy aligns with its commitment to a sustainable global economy. Similarly, Pramanik et al. [58] describe social and environmental reports as tools for companies to communicate their social and environmental efforts to relevant stakeholders.

Iredele & Akinlo [15] also stated that environmental advertising is a means of communicating the ecological performance of the company to various stakeholders of organizations. This study introduces environmental reporting as part of sustainability reporting, especially the analysis of information on community participation, human resources, environmental impact, energy efficiency and product safety, and their impacts on the environment and the organization. The discussions on the environmental responsibility of the company have encouraged sustainability processes with the proper introduction of methods such as human capital, social analysis, results (3BL) advertising and the introduction of our corporate social responsibility (CSR) report [16]. The increasing demand for data security has encouraged international environmental protection, with organizations such as the United Nations Environment Programme (UNEP) and the World Commission on Environment and Development (WCED) proposing a business that protects the biosphere [17].

Green accounting, also known as environmental accounting, is key in promoting sustainability by addressing present needs while preserving resources for future generations to meet their own needs. Environmentally conscious firms play a crucial role in this endeavour by measuring, disclosing, and being accountable for their performance toward sustainable development [18]. Green accounting or reporting, often synonymous with sustainability reporting, should present the organization’s work environment in a balanced and fair manner, including both positive and negative outcomes.

The drive for environmental sustainability has led to the rise of global firms promoting norms that guide human-environment interaction [19]. Growing environmental awareness and the push for sustainable development have shifted corporate priorities toward addressing environmental costs, including areas like product design, recycling, process innovation, worker training, and research and development. Government policies, social expectations, and the preferences of environmentally conscious consumers have intensified corporate focus on the strategic and competitive value of environmental responsibility.

For environmental accounts, statistics are prepared alongside economic data to integrate natural resource usage and environmental considerations into national accounts [20]. Bassey et al. [21] discuss two perspectives on profitability and voluntary disclosure: more profitable firms may disclose more information to distinguish themselves, while less profitable firms may do so to explain poor performance. The relationship between disclosure and profitability is complex; environmentally conscious firms may achieve higher profitability due to public preference, especially in industries like oil and gas. However, this may not hold for firms that neglect their environmental responsibilities. This study decomposed environmental accounting disclosure into two categories, the environmental conservation cost and environmental pollution remediation.

2.1.2. Environmental Conservation Cost

Environmental conservation has become a critical issue in the fight against climate change and global warming. It involves practices by individuals, organizations, and governments to safeguard natural resources and protect the environment. The key reasons for environmental conservation include eliminating pollution, conserving resources for future generations, ensuring biodiversity protection, implementing sustainable development, restoring environmental balance, and mitigating the devastating effects of global warming. Issues like overpopulation, water scarcity, ozone layer depletion, deforestation, desertification, and pollution present serious risks to human survival. Effective environmental conservation requires a collective effort, leveraging modern digital communication to drive a global movement for environmental protection.

The costs associated with environmental conservation are of increasing interest to scholars and practitioners, particularly regarding their impact on corporate financial performance. Environmental conservation costs may encompass expenditures associated with pollution control, waste management, resource preservation, and adherence to environmental regulations. The concept of "green accounting" or environmental accounting underscores the importance of integrating these costs into the financial reports of organizations. This approach helps firms measure, disclose, and be accountable for their environmental impact, contributing to sustainable development [22].

The Stakeholder Theory [23] and the Resource-Based View (RBV) [24] offer a theoretical framework for analyzing the connection between environmental conservation costs and financial performance. According to the Stakeholder Theory, companies have a responsibility

to manage relationships with various stakeholders, including the environment. Investing in environmental conservation aligns with stakeholder interests and can enhance corporate reputation, leading to competitive advantages. RBV suggests that firms can achieve a sustained competitive advantage through resources that are valuable, rare, difficult to imitate, and not easily substitutable. Environmental conservation efforts, when effectively managed, can be such a resource, leading to long-term financial benefits.

Empirical research has examined the influence of environmental conservation costs on financial performance, yielding mixed outcomes. While some studies indicate that adopting proactive environmental strategies can enhance financial performance, these improvements are often attributed to factors such as greater operational efficiency, increased innovation, and strengthened stakeholder relationships [25]. For instance, Oti & Mbu-Ogar [26], found that Nigerian oil and gas companies that invested in environmental conservation experienced positive financial outcomes. On the other hand, other studies indicate that high environmental costs can strain financial resources, potentially leading to lower profitability, especially in the short term [27].

Drawing from both theoretical foundations and empirical evidence, the following hypothesis is formulated:

H1: Environmental conservation costs significantly impact the financial performance of Nigerian oil and gas companies.

2.1.3. Environmental Pollution Remediation

Environmental pollution remediation involves actions to prevent, monitor, and mitigate the environmental impact of industrial activities. These costs are typically categorized into prevention, appraisal, internal failure, and external failure activities [28]. Prevention activities are proactive measures aimed at solving environmental problems before they occur, converting potential issues into opportunities. These costs are often seen as investments since they can minimize future expenditures and provide long-term benefits. Appraisal activities involve monitoring environmental impacts, such as auditing supplier performance, inspecting processes, and measuring damage. Internal failure activities address issues identified during appraisals, such as cleaning up spills or addressing occupational health and safety claims. External failure activities are more severe and occur when remediation efforts extend beyond the organization's control, including cleaning polluted sites and paying fines or penalties.

Environmental pollution remediation costs are incurred by organizations to prevent, monitor, and report environmental impacts. Environmental conservation costs can be categorized into conventional, hidden, contingent, image and relationship, and societal costs [29]. These are generally grouped into private costs, incurred by the firm, and societal costs, which are borne by the community. Remediation costs cover a wide range of expenditures, including legal, engineering, and consulting services; activities such as investigation, testing, sampling, and monitoring; excavation and construction work; removal or modification of equipment or facilities; and the safe disposal of hazardous materials [30].

The legitimacy theory suggests that companies strive to align their operations with societal norms and expectations [31]. The engagement in environmental pollution remediation and other social activities by companies can legitimize their operations and gain societal approval, which can translate into financial benefits [32]. The Stakeholder Theory further emphasizes that companies must manage their relationships with various stakeholders, including the environment, to maintain long-term success. Effective environmental remediation can enhance a company's reputation, reduce risks, and potentially improve financial performance [33].

Research investigating the relationship between environmental pollution remediation costs and financial performance has yielded varied findings. For example, Okafor [34], found a positive association between environmental remediation costs and financial performance. These studies suggest that companies that invest in environmental remediation may experience improved efficiency, reduced risks, and enhanced reputational capital, all of which contribute to better financial outcomes. However, Baribefe [35] and Aremu & Adegbie [36] reported a negative relationship, indicating that high remediation costs can strain financial resources and reduce profitability, especially in the short term.

Agboola et al. [37] highlighted that pollution control measures, particularly related to energy emissions and waste management, are critical indicators of operational efficiency. Excess emissions and waste are often viewed as signs of inefficient operations and environmental irresponsibility, leading to higher remediation costs [38]. Bansal & McKnight [39] emphasized that firms with effective pollution prevention strategies tend to achieve lower levels of emissions and waste, thereby reducing their overall remediation costs.

Drawing from both theoretical and empirical literature, the following hypothesis is formulated:

H2: Environmental pollution remediation costs have a significant impact on the financial performance of oil and gas companies in Nigeria.

2.2. Theoretical Framework

The relationship between environmental accounting costs and financial performance can be analyzed through several theoretical lenses. The following theories provide a foundation for understanding the linkages within the conceptual framework in Figure 1.

2.2.1. Stakeholder Theory

Stakeholder theory posits that companies are accountable to a broad range of stakeholders, including the

community, environment, and regulators, not just shareholders. In environmental accounting, this theory suggests that transparent disclosure of environmental efforts, such as conservation and pollution remediation, can build trust and support from stakeholders, leading to better financial performance [40].

According to Trang et al. [41], companies should incorporate the interests of diverse stakeholder groups, such as employees, customers, and the local community, into their corporate goals. Freeman [23] defines stakeholders as any group or individual affected by a firm's actions, highlighting the importance of environmental disclosures. Carroll [42] similarly notes that stakeholders such as local communities and governmental bodies are crucial in holding firms accountable for their environmental impact.

Bassey et al. [21] argue that managing stakeholder relationships is key to a firm's success, particularly in environmental accounting. Freeman [23] outlines two models of stakeholder theory: (1) a business planning and policy model, which stresses aligning corporate strategies with stakeholder expectations, and (2) a corporate social responsibility model, which emphasizes environmental stewardship to meet societal expectations and enhance legitimacy.

2.2.2. Legitimacy Theory

Legitimacy theory suggests that companies adapt their operations to align with societal norms and values, especially in industries with a significant environmental impact, such as oil and gas, to preserve their legitimacy. This theory suggests that firms disclose environmental information to legitimize their activities, enhance their reputation, and improve financial performance. Legitimacy is achieved when a company's actions are perceived as fair and socially acceptable, but gaps can arise if there's a mismatch between societal expectations and the firm's behaviour. Transparent disclosure practices are essential in maintaining or restoring legitimacy.

Deegan [43] highlights that legitimacy theory reflects the relationship between organizations and societal expectations, emphasizing that a company's survival depends on meeting these expectations. The theory suggests that organizations must fulfil their social role by aligning actions with societal needs [43]. Terdpaopong et al. [44] argue that corporate social and environmental responsibilities are crucial for communication with stakeholders, helping companies maintain legitimacy even if their actions deviate from expectations. Companies adopt strategies to align with public expectations, maintaining their social contract with society.

Legitimacy theory is widely used to explain how companies respond to social pressure by providing social responsibility information, which shapes both social and financial outcomes. Bassey et al. [21] define legitimacy as the perception that an entity's actions are appropriate within societal norms. Tilling [45] asserts that legitimacy theory helps explain voluntary social and environmental costs, facilitating public debate. Emma et al. [46] emphasize that a company's continued operation depends on societal perception of its legitimacy, with accountability playing a key role in mitigating environmental risks

2.2.3. Resource-Based View (RBV)

RBV posits that firms can attain and maintain a competitive advantage by strategically managing their distinct resources and capabilities, provided these assets are valuable, rare, difficult to replicate, and irreplaceable [24]. In environmental accounting, RBV views environmental disclosure as a strategic resource that can enhance a firm's reputation and strengthen relationships with stakeholders, including investors and customers. By committing to environmental sustainability, firms can differentiate themselves in the market, leading to improved financial performance.

Effective management of environmental costs, such as conservation and pollution remediation, can enhance a company's reputation as a responsible corporate citizen, fostering stronger customer loyalty and reducing capital costs by lowering investors' risk perceptions [47]. Environmental disclosure also signals a firm's commitment to sustainability, enhancing legitimacy, attracting environmentally conscious consumers, and improving employee morale, which contributes to better financial outcomes [47].

In industries like oil and gas, where environmental risks are high, firms that invest in environmental initiatives and transparently disclose these efforts can gain a competitive edge by positioning themselves as leaders in corporate responsibility [48]. RBV highlights the strategic value of environmental accounting disclosure in enhancing a firm's reputation and stakeholder relationships, ultimately leading to a sustainable competitive advantage and better financial performance.

3. Methodology

3.1. Research Design

In this study an Ex Post Facto research design and a quantitative methodology were deployed to analyze pre-existing data without altering any variables, ensuring an objective assessment of the relationship between the two variables (environmental accounting costs and financial performance) of oil and gas companies. The study population consisted of thirteen (13) oil and gas firms quoted on the Nigerian Exchange Limited (NGX). A purposive sampling technique was employed using 10 firms selected from both the upstream and downstream sectors based on data availability for the period under review. This selection generated 400 observations spanning 10 years (2013–2022).

3.2. Data Sources

The annual reports of the various selected firms of the oil and gas sector listed on NGX were the source of the secondary data utilized in this study. It focuses on examining environmental accounting costs over the period spanning 2013 to 2022.

3.3. Methods of Data Analysis

3.3.1. Descriptive Analysis

Univariate analysis was conducted to describe the dependent (financial performance) and independent (environmental accounting disclosure) variables using mean scores and percentages.

3.3.2. Inferential Analysis

Unit Root Test: The Augmented Dickey-Fuller (ADF) and Phillips-Perron tests were conducted to verify the stationarity of the data.

Co-integration Test: The Johansen Co-integration technique was applied to determine the existence of long-term relationships among the variables.

Ordinary Least Squares (OLS): OLS multiple regression analysis was utilized to evaluate the effect of environmental accounting costs on financial performance, specifically examining their influence on Return on Assets (ROA) and Net Profit Margin (NPM).

Error Correction Model: ECM was employed to correct short-term deviations and restore long-run equilibrium.

Granger Causality Test: Used to assess the causal relationship between the variables of interest in this study.

3.4. Model Specifications

To study the effect of environmental accounting costs (EAC) variables and financial performance (PF) variables, following Agbiogwu et al. [49], the paper used a modified Cobb-Douglas production function, thus the models are formulated:

$$ROA_{it} = \alpha_i + \beta_1 ECC_{it} + \beta_2 EPRC_{it} + e \quad (1)$$

$$NPM_{it} = \alpha_i + \beta_1 ECC_{it} + \beta_2 EPRC_{it} + e \quad (2)$$

Where NED represents the return on assets, ECC is the economic conservation cost, EPRC is the environmental pollution remediation cost, and NPM is the net profit margin. To standardize the data for regression analysis, we followed the approach of Gillette & Robert [50], who recommended using natural logarithms for both the dependent and independent variables in linear regression. This method allows for elasticity analysis, which is unit-independent and simplifies the interpretation of results. Therefore, the data were transformed into their natural logarithmic (log) form as follows:

$$InROA_{it} = \alpha_i + \beta_1 (InECC_{it}) + \beta_2 (InEPRC_{it}) + e \quad (3)$$

$$InNPM_{it} = \alpha_i + \beta 1 (InECC_{it}) t + \beta_2 (InEPRC_{it}) + e \quad (4)$$

Where InROA is the natural logarithmic (log) of ROA, InNPM is the natural logarithmic (log) of NPM, InECC is the natural log of environmental conservation cost, and InEPRC is the natural log of environmental pollution remediation cost.

4. Results and Discussion

4.1. Descriptive Statistics

Table 1 shows an overview of the descriptive statistics for four primary variables: Environmental Conservation Cost (ECC), Environmental Pollution Remediation Cost (EPRC), ROA, and NPM, based on a total of 100 observations. The statistics presented include the average, median, max, mini, standard deviation, skewness, kurtosis, and the Jarque-Bera test for normality (Appendix Table A). The mean of ECC value is ₦63,101,330, while the median is slightly lower at ₦54,406,971, indicating that ECC values are somewhat symmetrically distributed but with a slight right skew. EPRC had a mean value of ₦20,704,572, with a median of ₦10,042,300, suggesting that the distribution of EPRC is more right-skewed, as the mean is significantly higher than the median. The mean of ROA is 0.2028 (20.28%), with a median of 0.11 (11%), indicating that most companies have a lower ROA, but some high values are pulling the mean upwards. The mean NPM is 9.2752%, and the median is 10.02%, showing a near-normal distribution for NPM with the mean slightly below the median. The maximum ECC reported is ₦163 million, while the minimum is ₦768,500. This large range indicates a significant variability in environmental conservation costs across companies. The maximum EPRC is ₦81.1 million, and the minimum is ₦6.45 million, suggesting wide disparities in pollution remediation efforts. The maximum ROA is 80%, and the minimum is 1%, showing a broad range of profitability among the companies. The maximum NPM is 17.3%, and the minimum is 1%, indicating considerable variations in net profitability. ECC had a standard deviation which is ₦50,009,057, indicating high dispersion in ECC around the mean. With a standard deviation of ₦18,910,164, EPRC also shows a substantial variability. ROA with a standard deviation of 0.221, suggesting a moderate variability in ROA among companies. NPM has a standard deviation of 5.27% reflecting a moderate variation in NPM.

ECC has a skewness of 0.393, indicating a slight right skew, meaning there are more observations with ECC values below the mean. EPRC has a skewness of 1.728, which is highly positive, suggesting that a few companies have very high EPRC values compared to the rest. ROA has a skewness of 1.653, indicating a strong positive skew, where most companies have lower ROA values, with a few having much higher values. NPM has a skewness of -0.097, close to zero, indicating that NPM is almost symmetrically

distributed (Appendix A).

ECC has a Kurtosis of 2.043, close to the normal distribution (kurtosis of 3), indicating a near-normal distribution. The EPRC of Kurtosis is 5.328, indicating a leptokurtic distribution with more data concentrated around the mean and heavier tails. ROA of Kurtosis is 4.828, also leptokurtic, indicating more extreme values than in a normal distribution. The NPM of Kurtosis is 1.9804, suggesting a platykurtic distribution, with lighter tails and a flatter peak than a normal distribution. ECC has a Jarque-Bera statistic of 1.406 with a probability of 0.495, suggesting that the ECC data does not significantly deviate from normality. EPRC has a Jarque-Bera statistic of 18.095 with a p-value of 0.0001, indicating a significant deviation of EPRC distribution from normality. ROA has a Jarque-Bera statistic of 14.8787 with a probability of 0.0006, showing that ROA distribution significantly deviates from normality. NPM has a Jarque-Bera statistic of 1.122 with a probability of 0.570, suggesting that NPM is normally distributed.

These statistics provide the aggregate values and the sum of squared deviations from the mean, which are useful for understanding the overall scale and dispersion in the data. The descriptive statistics indicate a significant variability in the environmental accounting costs (ECC and EPRC) and financial performance metrics (ROA and NPM) among the sampled forms. The data shows skewness and kurtosis values, which suggest that ECC and ROA have moderate right skews with some companies incurring significantly higher costs and achieving higher returns. In contrast, NPM is nearly symmetrical and normally distributed. The presence of non-normality in some variables (EPRC and ROA) as indicated by the Jarque-Bera test suggests that care should be taken when applying parametric statistical methods, and transformations or robust statistical techniques may be required.

These observations highlight the diversity in environmental practices and financial outcomes among companies, suggesting that while some companies invest heavily in environmental conservation and pollution remediation, others do not, leading to varied financial performance results. This variability should be considered in the regression analysis to determine the true impact of environmental accounting disclosure on financial performance.

Table 1. Descriptive statistics of the oil and gas sector

Variable	Obs.	Mean	SD	Min.	Max.
ROA	100	0.2028	0.2219	0.0100	0.8000
NPM	100	9.2752	5.2701	1.0000	17.300
ECC	100	63101330	50009057	768500	1.63E+08
EPRC	100	20704572	18910164	6453700	81146000

Notes: ECC, economic conservation cost; EPRC, environmental pollution remediation cost; ROA, return on assets; NPM, net profit margin

4.2. Unit Root Test Results

Table 2 displays the outcomes of the Augmented Dickey-Fuller (ADF) unit root test, which checks the stationarity of the data series. Stationarity means the statistical properties like mean and variance, remain constant over time—a crucial requirement for time-series analysis.

The ADF test results show that all variables (ECC, EPRC, ROA, NPM) became stationary at their first difference. The test statistics for each variable are lower than the Mackinnon critical values at various significance levels, leading to the rejection of the null hypothesis of non-stationarity. Additionally, p-values for all variables are below 0.05, providing further confirmation that the variables achieve stationarity after a single differencing.

Ensuring stationarity is essential to avoid spurious regression results, and the findings align with previous studies like those by Agbiogwu et al. [49], which stress the importance of unit root tests in reliable econometric modeling. The stationarity of these variables justifies using co-integration analysis and ECM in subsequent analyses to explore the long-run relationships between environmental accounting costs (EAC) and financial performance metrics (ROA and NPM).

In summary, the ADF test confirms that ECC, EPRC, ROA, and NPM are stationary at the first difference, providing a solid foundation for the study's econometric analysis and ensuring the reliability of its findings.

Table 2. Unit Root Test

Variable	ADF Statistics	Mackinnon 1% Critical Value	Mackinnon 5% Critical Value	Mackinnon 10% Critical Value	Order of Integration	Prob.
ECC	-21.35278	-3.808546	-3.020686	-2.650413	1(1)	0.0000
EPRC	-5.076787	-3.808546	-3.020680	-2.650413	1(1)	0.0007
ROA	-7.388132	-3.808546	-3.020686	-2.650413	1(1)	0.0000
NPM	-5.279227	-3.808546	-3.020686	-2.650413	1(1)	0.0004

Notes: ECC, economic conservation cost; EPRC, environmental pollution remediation cost; ROA, return on assets; NPM, net profit margin

4.3. Co-integration Test

Table 3 summarizes the Co-integration Test, which evaluates whether a long-term equilibrium relationship exists between Environmental Conservation Cost (ECC), Environmental Pollution Remediation Cost (EPRC), ROA, and NPM. The results indicate two co-integrating equations at the 5% significance level, suggesting a long-term relationship between these variables. The null hypothesis for "None" and "At most 1" co-integrating equations is rejected, confirming the presence of at least two co-integrating relationships. For the first hypothesis ("None"), the trace statistic of 112.006 exceeds 69.818 (the critical value) with a p-value (0.0000). Similarly, for the second hypothesis ("At most 1"), the trace statistic of 57.145 exceeds the critical value of 47.856 with a probability of 0.0053. In contrast, for "At most 2," "At most 3," and "At most 4," the trace statistics remain below their respective critical values, suggesting no additional co-integrating relationship beyond the first two.

The presence of these two co-integrating equations implies a stable long-term relationship between ECC, EPRC, ROA, and NPM, despite short-term fluctuations. This suggests that changes in environmental accounting (ECC and EPRC) are likely to have lasting impacts on financial performance (ROA and NPM) in the oil and gas sector.

These results are consistent with earlier research, such as the study by Agbiogwu et al. [49], who also identified that exists among the study variables. The results reinforce the importance of sustainable practices and their positive impact on a company's long-term profitability.

In summary, the Johansen Multivariate Co-integration Test confirms two significant co-integrating relationships among ECC, EPRC, ROA, and NPM, indicating that investments in environmental sustainability are crucial for enhancing long-term financial performance.

The Maximum Eigenvalue Test presented in Table 4 confirms the presence of two co-integrating equations among the variables, consistent with the trace test results. This indicates that the environmental accounting variables (ECC and EPRC) and financial performance indicators (ROA and NPM) maintain a stable long-term relationship, further emphasizing the importance of environmental accounting practices in sustaining financial performance. The findings align with previous studies in the field, reinforcing the view that investments in environmental sustainability are crucial for achieving long-term profitability and stability in the oil and gas sectors.

The Johansen Maximum Eigenvalue Test assesses the number of co-integrating relationships among variables in the model by comparing the maximum eigenvalue statistic to its critical value at the p-value (0.05). For the "None" hypothesis, the maximum eigenvalue statistic of 54.861 is greater than the critical value of 33.87, with a p-value of 0.0001, indicating at least one co-integrating equation. Similarly, the "At most 1" hypothesis shows a maximum eigenvalue statistic of 36.02590, surpassing the critical value of 27.58434 with a probability of 0.0033, suggesting a second co-integrating relationship.

However, for "At most 2," "At most 3," and "At most 4," the maximum eigenvalue statistics do not exceed their critical values, confirming that no more than two co-integrating relationships exist. Maximum eigenvalue and trace tests indicate the presence of two co-integrating equations, confirming a stable long-term relationship among the variables. The maximum eigenvalue test is considered more reliable in determining the number of co-integrating vectors because it tests the largest eigenvalue individually.

The presence of two significant co-integrating relationships implies that environmental accounting measures (ECC and EPRC) and financial performance indicators (ROA and NPM) share a stable long-term equilibrium. This suggests that changes in environmental accounting practices will likely have lasting impacts on financial outcomes. These findings are consistent with studies by Aftab et al. [51], which also identified co-integrating relationships between environmental expenditures and financial performance in various sectors. The results emphasize the importance of integrating environmental sustainability into business strategies, as it contributes to regulatory compliance and enhanced long-term financial performance.

Table 3. Summary of Johansen Multivariate Co-integration Test Results (Trace Statistic)

Hypothesized		Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	Decision
None *	0.967575	112.0065	69.81889	0.0000	Reject
At most 1 *	0.894771	57.14524	47.85613	0.0053	Reject
At most 2	0.606934	21.11933	29.79707	0.3503	Accept
At most 3	0.208950	6.178904	15.49471	0.6744	Accept
At most 4	0.140829	2.428606	3.841466	0.1191	Accept

Trace Test Decision: The trace test indicates the presence of 2 co-integrating equ. at p-value (0.05). The asterisks (*) denote the rejection of the H_o at the 0.05 level

Table 4. Summary of Johansen Multivariate Co-integration Test Results (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	Decision
None *	0.967575	54.86123	33.87687	0.0001	Reject
At most 1 *	0.894771	36.02590	27.58434	0.0033	Reject
At most 2	0.606934	14.94043	21.13162	0.2931	Accept
At most 3	0.208950	3.750299	14.26460	0.8847	Accept
At most 4	0.140829	2.428606	3.841466	0.1191	Accept

The maximum eigenvalue test indicates the presence of 2 co-integrating equations at the 0.05 significance level. The asterisks (*) denote the rejection of the null hypothesis at the 0.05 level.

Table 4, in summary, indicated that the Maximum Eigenvalue Test confirms two co-integrating equations among the variables, indicating a stable long-term relationship between environmental accounting variables (ECC and EPRC) and financial performance indicators (ROA and NPM). This reinforces the view that investments in environmental sustainability are crucial for achieving long-term profitability and stability, particularly in the oil and gas sector.

4.4. Granger Causality Test Results

Table 5 shows that the null hypothesis stating that ECC (Environmental Cost Control) does not Granger Cause EPRC (Environmental Performance Reporting Costs) cannot be rejected at the 5% significance level, indicating no evidence of ECC predicting EPRC. However, the reverse—EPRC Granger Causes ECC—is rejected at the 10% level, suggesting a weak predictive relationship where EPRC might influence ECC.

The results also indicate no significant Granger causality between ROA (Return on Assets) and EPRC in either direction, as both hypotheses fail to be rejected. Similarly, no predictive relationship is found between NPM (Net Profit Margin) and EPRC, as neither H_0 is rejected. The findings also indicate no significant Granger causality between ROA and ECC, as both hypotheses fail to be rejected, indicating no predictive relationship. The H_0 that NPM does not Granger Cause ECC is accepted, showing any predictive effect of NPM on ECC. However, ECC weakly Granger Causes NPM at the 10% level, suggesting a potential predictive effect. Lastly, there is no significant predictive relationship between ROA and NPM, as both hypotheses fail to be rejected.

The Granger causality tests reveal limited predictive relationships between environmental accounting measures (ECC and EPRC) and financial performance indicators (ROA and NPM). Notably, there are weak predictive effects of EPRC on ECC and ECC on NPM at the 10% significance level, suggesting some interaction between environmental performance reporting, cost control, and profitability.

Overall, the Granger causality tests provide limited evidence of predictive relationships, with weak indications that environmental performance reporting could influence cost control, and that cost control may impact net profit margins. These findings offer insights into how environmental accounting might interact with financial performance in the oil and gas sector, though further investigation with different models or additional variables may be necessary to fully understand the dynamics.

4.5. Regression Results for ROA Model

Table 6 presents the results of the ROA model. ECC (economic conservation cost) has a coefficient of 48.700, but its associated p-value = 0.4950 ($p > 0.05, 0.01$) indicates that ECC is not statistically significant in predicting ROA (Return on Assets). This suggests that environmental cost control does not have a strong direct impact on the return on assets for the sample data used. Hence, this finding negates the studies by Onyeneho et al. [52], who found a significant association between environmental costs and the growth of oil firms in Nigeria.

EPRC (environmental pollution remediation cost), on the other hand, has a significant coefficient value of 13.50 and a P-value of 0.0038 ($p< 0.01$). This implies that EPRC positively impact ROA, suggesting that effective environmental performance reporting can contribute to improved financial performance in terms of return on assets. This result agrees with Nnamani et al [53], who found a positive and significant effect of green accounting and firm value in Nigeria. However, the finding contradicts Tu & Huang [12], who found that the Taiwan stock exchange has a significant negative effect on environmental reporting on the return on assets.

The R-squared value of 0.3272 reveals that an approximately 32.72% change in ROA is explained by the model, which includes ECC and EPRC. This is a moderate level of explanatory power, meaning that while the model accounts for some variation in ROA, there are other factors not captured by ECC and EPRC that also influence ROA.

The standard error for ECC is relatively high (69.900), leading to a low t-statistic (0.695), which aligns with its high p-value, indicating a lack of significance. On the other hand, the standard error for EPRC is lower (40.800), and its t-statistic (3.299) is high enough to confirm the statistical significance of EPRC's positive impact on ROA.

The Durbin-Watson stat of 1.226 is below the ideal value of 2, indicating some potential issues with the autocorrelation in the residuals, though it is not definitive.

The results highlight the significant role of environmental pollution remediation cost (EPRC) in enhancing a firm's ROA. The positive and statistically significant relationship suggests that firms that invest in transparent and effective environmental reporting may see an improvement in their financial performance, possibly due to enhanced corporate reputation, better compliance with regulations, or more efficient resource utilization.

The non-significance of economic conservation cost (ECC) in predicting ROA, as observed in this study, may indicate that simply controlling environmental costs does not directly translate into financial gains. This could be due to various factors such as the initial costs of implementing environmental controls, the time lag before such controls translate into financial benefits, or the possibility that other factors overshadow the impact of ECC on ROA.

The moderate R-squared value implies that while environmental factors like ECC and EPRC play a role, other non-environmental factors also significantly contribute to a firm's financial performance, suggesting that a more comprehensive model may be required to fully explain the variations in ROA.

The regression analysis reveals that environmental pollution remediation cost (EPRC) has a significant positive impact on return on assets (ROA), while economic conservation cost (ECC) does not show a significant direct effect. The results support the idea that transparent environmental reporting can enhance financial performance, aligning with findings from other studies in corporate social responsibility and environmental accounting literature. However, the model's moderate explanatory power and the potential issue of autocorrelation suggest that further research with additional variables and model refinements is needed to better understand the relationship between environmental practices and financial performance.

Table 7 shows the regression results for the NPM Model, ECC has a coef. of -57.900 with a $p > 0.05$ (0.2325), indicating that it is not statistically significant in predicting NPM (Net Profit Margin). This suggests that environmental cost control may have a negative but insignificant impact on NPM.

EPRC has a coef. = -28.300 and p-value = 0.3139, also indicating insignificance. Hence, EPRC insignificantly impacts NPM. The R^2 value of 0.1640 suggests that about 16.40% change in NPM is accounted for by the model indicating a relatively low level of explanatory power. This implies other variables not factored into the model are likely influencing NPM. The standard error for ECC and EPRC is relatively low, but their t-statistics (-1.233 for ECC and -1.034 for EPRC) suggest that they are not significant contributors to the model. The DW stat of 1.973 is close to 2, indicating that there is likely no serious issue with autocorrelation in the residuals, which suggests that the regression results are reliable.

The findings reveal that ECC and EPRC are not significant predictors of NPM.

However, the low R^2 value indicates that the model only captures a small portion of the factors influencing NPM, suggesting that other variables, such as market conditions, firm size, and industry-specific factors, may also play crucial roles. This finding is consistent with the notion that profitability is influenced by a wide array of factors beyond just environmental costs and reporting practices. The regression analysis indicates that economic conservation cost (ECC) and environmental pollution remediation (EPRC) do not significantly impact the NPM. However, the model's low explanatory power suggests the need for further research to include additional variables and refine the analysis to better understand the drivers of profitability about environmental practices.

Table 5. Summary of Pairwise Granger Causality Tests

Null Hypothesis	Obs	F-Statistic	Probability	Decision
ECC does not Granger Cause EPRC	100	1.59852	0.2296	Fail to Reject Null
EPRC does not Granger Cause ECC	100	3.81496	0.0616	Reject Null (at 10% level)
ROA does not Granger Cause EPRC	100	1.78727	0.1959	Fail to Reject Null
EPRC does not Granger Cause ROA	100	0.30268	0.7425	Fail to Reject Null
NPM does not Granger Cause EPRC	100	0.63224	0.5428	Fail to Reject Null
EPRC does not Granger Cause NPM	100	2.41601	0.1176	Fail to Reject Null
ROA does not Granger Cause ECC	100	0.01954	0.9807	Fail to Reject Null
ECC does not Granger Cause ROA	100	0.88377	0.4304	Fail to Reject Null
NPM does not Granger Cause ECC	100	1.34954	0.2844	Fail to Reject Null
ECC does not Granger Cause NPM	100	3.74725	0.0636	Reject Null (at 10% level)
NPM does not Granger Cause ROA	100	0.32826	0.7244	Fail to Reject Null
ROA does not Granger Cause NPM	100	2.35532	0.1234	Fail to Reject Null

Notes: ECC, economic conservation cost; EPRC, environmental pollution remediation cost; ROA, return on assets; NPM, net profit margin

Table 6. OLS Regression of ROA on Environmental Accounting Disclosure

Variables	$InROA_{it}=\alpha_i+\beta_1(InECC_{it})+\beta_2(InEPRC_{it}) + e$			(3)	
InROA	Coef.	*t*-value	SE	*p*-value	Sig.
InECC	48.700	0.695	69.900	0.4950	
InEPRC	13.500	3.299	40.800	0.0038	**
R^2	0.3272				
DW	1.226				

Notes: ECC, economic conservation cost; EPRC, environmental pollution remediation cost; ROA, return on assets; DW, Durbin-Watson

Table 7. OLS Regression of NPM on Environmental Accounting Disclosure

Variables	InNPMit=αi+β1(InECCit)+β2(InEPRCit) + e			(4)	
InNPM	Coef.	t-value	SE	p-value	Sig.
InECC	-57.900	-1.233	4.690	0.2325	
InEPRC	-28.300	-1.034	2.740	0.3139	
R2	0.1640				
DW	1.973				

Notes: ECC, economic conservation cost; EPRC, environmental pollution remediation cost; NPM, net profit margin; DW, Durbin-Watson

5. Discussion of Findings

This study examined the relationship between economic conservation costs (ECC) and environmental pollution remediation costs (EPRC) on the financial performance of firms, specifically focusing on their impact on ROA and NPM. The study's findings reveal significant insights into how these environmental costs influence firm profitability and provide valuable contributions to the ongoing discourse on corporate sustainability and financial performance.

The study revealed that ECC had an inverse but statistically insignificant impact on both ROA and NPM. This suggests that while firms may be investing in controlling their environmental costs, such investments do not directly translate into improved profitability. Although environmental cost control is necessary for regulatory compliance and risk management, it might not immediately yield financial returns. The lack of significance might also suggest that the benefits of ECC, such as enhanced reputation and long-term savings, may take time to materialize and thus do not have an immediate impact on profitability.

Empirical studies have shown mixed results regarding the impact of environmental costs on financial performance. For example, King & Lenox [54] found that firms that invest in pollution prevention technologies often face initial costs that are not offset by short-term financial gains. However, these investments may lead to long-term benefits, such as cost savings from reduced waste and improved operational efficiency [55]. This study’s findings align with the view that while ECC is crucial for long-term sustainability, its immediate impact on financial metrics like ROA and NPM may be limited.

The study also reported that EPRC had a negative but statistically insignificant effect on NPM, suggesting that the costs associated with reporting environmental performance may not directly enhance profitability. This finding can be interpreted through the lens of Legitimacy Theory, which believes that the goal of disclosing environmental performance pursued by companies agrees with stakeholders' expectations and maintains their legitimacy. While these disclosures are important for managing stakeholders' perceptions, they may not directly influence financial performance. Instead, the benefits of EPRC might be realized in terms of improved stakeholder relationships, enhanced corporate image, and potentially reduced costs of capital, rather than immediate profitability.

Empirical studies support this interpretation. For instance, Clarkson et al. [56] found that while environmental disclosures can improve a firm's reputation and stakeholder trust, these benefits do not necessarily translate into immediate financial gains. The costs of implementing and maintaining robust environmental reporting systems may outweigh the short-term financial benefits [55], particularly in industries where environmental performance is closely scrutinized.

The study's regression models indicated low R-squared and adjusted R-squared values, suggesting that ECC and EPRC together explain only a small portion of the variance in ROA and NPM. This finding suggests that while these environmental cost variables are important, other factors not included in the model may also play crucial roles in determining firm profitability. Market conditions, firm size, industry-specific dynamics, and management practices might also significantly influence financial performance.

The relatively low explanatory power of the model highlights the complexity of the relationship between environmental costs and financial performance. This aligns with the broader empirical literature, which often finds that

various contextual factors mediate the impact of environmental practices on financial outcomes. For instance, Ambec & Lanoie [57] found that the financial benefits of environmental practices are often contingent on industry characteristics, regulatory environments, and firm-specific factors.

The findings of this study have important theoretical and empirical implications. Theoretically, the study contributes to the ongoing discourse on the financial implications of corporate sustainability. It provides empirical support for the Resource-Based View (RBV) and Legitimacy Theory, highlighting the strategic value of sustainability investments and the role of environmental reporting in maintaining legitimacy. However, the study also underscores the limitations of these theories in fully explaining the relationship between environmental costs and financial performance, suggesting the need for more integrative theoretical frameworks that account for this relationship's complexity and multifaceted nature.

Empirically, the study adds to the growing body of literature on corporate sustainability by providing evidence from a specific context, offering insights into how environmental costs affect firm profitability. The findings suggest that while sustainability investments can enhance profitability, the financial benefits of environmental reporting and cost control may be more nuanced and context-dependent. This has practical implications for managers and policymakers, indicating that while investing in sustainability is beneficial, a nuanced approach that considers the specific context and strategic objectives is essential.

6. Conclusions

This study sheds light on the complex relationship between environmental costs and financial performance. While EPRC positively impacts financial performance, the effects of ECC are less clear and may depend on various contextual factors. These findings contribute to the ongoing debate on the financial implications of corporate sustainability and suggest that while environmental sustainability can be a source of competitive advantage, its financial benefits are not guaranteed and may require a strategic and context-sensitive approach.

Appendix

Table A. Descriptive Statistic

	ECC	EPRC	ROA	NPM
Mean	63101330	20704572	0.202800	9.275200
Median	54406971	10042300	0.110000	10.02000
Maximum	1.63E+08	81146000	0.800000	17.30000
Minimum	768500.0	6453700.	0.010000	1.000000
Std. Dev.	50009057	18910164	0.221933	5.270110
Skewness	0.393258	1.728571	1.653829	-0.097755
Kurtosis	2.043332	5.328074	4.828367	1.980411
Jarque-Bera	1.406002	18.09557	14.87867	1.122693
Probability	0.495097	0.000118	0.000588	0.570440
Sum	1.39E+09	5.18E+08	5.070000	231.8800
Sum Sq. Dev.	5.25E+16	8.58E+15	1.182104	666.5774
Observations	100	100	100	100

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