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Environmental costs and the profitability of listed oil and gas companies in Nigeria

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Abstract

This study explores how environmental costs influences the profitability of Nigerian oil and gas firms. It specifically investigates the impact of environmental pollution prevention cost and environmental pollution detection cost, community development cost on return on capital employed. Grounded in stakeholder theory, the research focuses on six of the eight oil and gas companies listed on the Nigerian Exchange Group (NGX), chosen for their complete panel data, over a twelve-year span from 2013 to 2024. Data utilized were obtained from companies' annual reports, and various statistical methods were applied, including descriptive analysis, correlation analysis and Panel Least Squares (PLS) regression using STATA software. Hausman test was carried out to ascertain validity and reliability of data. The study found that environmental accounting metrics, including pollution prevention, pollution detection, and community development costs, significantly improve the return on capital employed (ROCE) of oil and gas companies listed in Nigeria, indicating that such investments enhance profitability and company reputation. Based on these findings, it is recommended that companies allocate more resources to environmental protection, prioritize disclosure of environmental costs in financial reports, and ensure compliance with environmental regulations to strengthen relationships with stakeholders and improve financial outcomes.

Keywords: Community development Cost, Detection cost, Environmental costs, Profitability, Oil and gas companies

1. Introduction

The oil and gas sector is a cornerstone of Nigeria's economy, contributing significantly to revenue and employment. However, the industry faces increasing scrutiny due to its environmental impact, particularly in the Niger Delta, where issues such as oil spills, gas flaring, and pollution are rampant (Adebayo, 2021). As the world shifts toward sustainability, oil and gas companies are under pressure to manage environmental costs such as pollution prevention, detection, and community development while maintaining profitability (Smith and Chen, 2023). The industry's environmental footprint, particularly its effects on the environment and local communities, has led to increased calls for accountability (Nguyen, Tran and Nguyen, 2020). Environmental costs refer to the financial expenditures incurred by companies to prevent, detect, and mitigate the environmental impact of their operations (Linnenluecke, Griffiths and McDonald, 2022). In the context of Nigeria, environmental pollution prevention costs, pollution detection costs, and community development costs represent critical variables influencing corporate strategies in the oil and gas industry (Okonkwo, 2021).

Environmental pollution prevention costs encompass the investments made by companies to reduce emissions, manage waste, and implement eco-friendly technologies (Harrison, 2022). These expenditures, though often substantial, can result in long-term savings through improved operational efficiency and

enhanced regulatory compliance (Al-Zubaidi, Al-Saedi and Al-Abri, 2019). Pollution detection costs, which include expenses related to monitoring, auditing, and reporting pollution levels, ensure that companies meet environmental standards and avoid potential fines (Baker, Johnson and Lee, 2023). Community development costs represent the investments made by companies to contribute to the welfare of local communities impacted by their operations, further enhancing their social responsibility and corporate image (Rodriguez, 2023).

This study investigates the impact of environmental costs, specifically pollution prevention, detection, and community development expenditures, on the financial performance of publicly listed oil and gas companies in Nigeria. By analyzing the relationship between these environmental investments and key financial indicators, such as return on capital employed (ROCE), the research seeks to understand the trade-offs between sustainability initiatives and corporate profitability (Sheng, Chen and Qiu, 2023). While some studies such as Aloui et al. (2023) and Nguyen et al. (2020), suggest that these environmental costs negatively affect profitability by increasing operational expenses, Harrison (2022) and Rodriguez (2023) argue that long-term benefits, such as improved reputation and operational efficiency, can result from such investments. However, existing research often focuses on developed economies, leaving a gap in understanding how these dynamics play out in the context of Nigeria's oil and gas sector (Harrison, 2022).

The study aims to assess whether increased spending on environmental protection and community engagement contributes to improved financial outcomes, particularly in terms of capital efficiency and overall business performance (Linnenluecke, et al., 2022). The findings will offer valuable insights for corporate decision-makers, investors, and policymakers, helping them better understand the financial implications of environmental investments (Krueger, Hoffmann and Wagener, 2019). Additionally, the research will contribute to the academic discourse on the intersection of environmental costs and profitability, while emphasizing the long-term benefits for local communities and guiding oil and gas companies in Nigeria on how to strategically manage environmental expenditures to enhance both profitability and sustainable development (EIA, 2023).

Research Objectives

The core objective of this investigation is to examine the effect of environmental cost on the profitability of listed oil and gas companies in Nigeria. Other objectives are;

i. To examine the effect Environmental Pollution Prevention Cost on the profitability of listed oil and gas companies in Nigeria.

ii. To assess the effect of Environmental Pollution Detection Cost on the profitability of listed oil and gas companies in Nigeria.

iii. To analyze the effect of Community Development Cost on the profitability of listed oil and gas companies in Nigeria**.**

2. Literature Review

2.1 Conceptual Review

Concept of Environmental Cost

Environmental costs are crucial expenditures linked to a company's ecological impact and compliance with regulatory requirements, influencing both its financial performance and sustainability objectives (Muñoz-Quezada and Urriola, 2020). These costs are divided into direct and indirect categories. Direct costs include investments in pollution control and waste management, while indirect costs encompass reputational risks and potential legal liabilities (Lee and Min, 2021). Managing these costs effectively is essential for improving financial outcomes

and achieving sustainability goals (Nguyen et al., 2020). Although compliance with environmental regulations often incurs additional costs, it can also provide opportunities for innovation, competitive advantage, and long-term savings through improved operational efficiency (Linnenluecke et al., 2022; Al-Zubaidi et al., 2019). Transparent environmental reporting can attract investors and reduce capital costs (Krueger et al., 2019). Tools such as lifecycle analysis (Sheng, Chen and Qiu, 2023) and economic valuation (Heijungs and Huppes, 2019) help uncover hidden costs and externalities, facilitating better resource allocation and sustainability performance (Chen, Liu & Yu, 2020; Hotta and Yoshida, 2022). Environmental costs are typically classified into prevention costs (investments in pollution control and employee training), detection costs (monitoring and compliance assurance), and research and development costs (developing sustainable practices and technologies) (Baker et al., 2023). A comprehensive approach that integrates these categories enables companies to balance financial performance with environmental responsibility, meeting stakeholder expectations and fostering long-term sustainability (Harrison, 2022; Simmons, 2022).

Concept of Profitability

Profitability is a subjective measure of a company's ability to utilize its assets to generate income, reflecting its overall financial health (Riyadh, Al-Shmam, Huang, Gunawan, and Alfaiza, 2020). It is typically assessed through metrics such as profitability, market share growth, turnover, and return on capital employed (ROCE) (Emmanuel, 2021; Arumona, Lambe and Ogunmakinde, 2021). Profitability provides a clear indication of a company's ability to achieve its objectives over a specific period, rooted in its policies, missions, and investment returns (Verma, 2019; Okafor, 2018). A key component of assessing profitability is understanding how well a company generates revenue from its assets (Lusiana, Haat, Saputra, Yusliza and Muhammad, 2021).

ROCE is a critical financial indicator used to evaluate how effectively a business generates returns on its capital investments. It is calculated by dividing earnings before interest and taxes (EBIT) by the capital employed, which includes both debt and equity (Choiriah and Lysandra, 2023). ROCE serves as a benchmark for evaluating operational efficiency, capital allocation, and profitability, with a higher ROCE indicating effective capital utilization and stronger financial health (Brown, Smith, Johnson and Davis, 2020). The integration of environmental accounting practices has been shown to positively impact ROCE, particularly in sectors like oil and gas, where regulatory compliance and sustainability practices are increasingly important (Olaoye and Alao, 2023). By adopting robust environmental accounting frameworks, companies can enhance resource efficiency, mitigate risks, and maintain a competitive advantage, contributing to sustainable profitability and capital efficiency (Adams and Brown, 2022).

Brief Overview of Oil and Gas Industry in Nigeria

The Shell Group established a thriving oil and gas industry in Nigeria in 1956, dominating the sector until the early 1990s when local businesses began entering the market. The Nigerian Content Directives and the NOGIC Act of 2010 facilitated increased local participation in oil and gas projects (Okonkwo, 2021). The industry is divided into the upstream sector, which is vital to Nigeria's economy, accounting for over 90% of exports and 80% of government revenue (Sola, 2023), and the downstream sector, which focuses on refining and distributing products like petrol and diesel (Ogunleye, 2022). Despite challenges such as pipeline

vandalism, regulatory issues, and fluctuating oil prices, Nigeria remains a leading oil producer, contributing significantly to global oil markets and its own economy (EIA, 2023; OPEC, 2020). However, many companies in the sector fail to meet environmental reporting standards, damaging the industry's reputation and financial performance (Smith and Chen, 2023). Recent reforms aim to attract investment and enhance transparency, solidifying the sector's role as a key economic engine for Nigeria (EIA, 2023).

2.2 Theoretical Review

2.3.1 Stakeholder Theory

The underpinning theory for this study is Freeman's Stakeholder Theory, introduced in 1984, which emphasizes the importance of maintaining positive relationships with both internal and external stakeholders for organizational success (Freeman, 2010; Yaakoo, Ibanichuka and Ofurum, 2021). Internal stakeholders include employees, management, and the board of directors, while external stakeholders encompass shareholders, consumers, investors, communities, and government agencies (Yaakoo et al., 2021). The theory suggests that firms should measure and address their environmental impact by integrating environmental costs into their financial statements and offering sustainable plans that benefit all stakeholders (Polycarp, 2019; Horisch, Freeman, Schaltegger and Burritt, 2020). It also supports voluntary disclosure to enhance transparency and strengthen legitimacy and accountability in environmental management (Nguyen and Tran, 2019). Investments in Environmental Pollution Prevention Costs, Pollution Detection Costs, and Community Development Costs demonstrate a commitment to sustainability, which improves a company's reputation, enhances its performance, and fosters stakeholder support. By synthesizing existing literature, this study identifies research gaps and underscores the importance of theoretical frameworks in understanding the impact of environmental costs on financial performance. It also provides insights into how empirical findings based on Stakeholder Theory can guide both researchers and practitioners in managing environmental costs and their financial implications.

2.3 Empirical Review

Onuora and Chiedu (2019) assessed the financial performance and environmental accounting of seven Nigerian oil and gas firms from 2017 to 2018 with the uses of regression model. According to the study, return on capital employed (ROCE) was impacted by environmental costs but not gross profit margin (GM). The study concluded that, despite the environmental costs' minimal influence on financial performance, management of oil and gas companies should keep making responsible investments in these areas. The minimal impact of environmental costs on GM but significant on ROCE suggests that environmental costs affect certain financial metrics more than others. A longer study period or broader range of environmental factors might yield more comprehensive results.

Ilelaboye and Alade (2022) found out that health and safety cost have a pragmatic and footling effect on fiscal returns, while community development cost was found to be negatively influencing the financial strength of family owned hydrocarbon firms in Nigeria. However, Akinleye & Olaoye (2021) investigate the influence of CDC on the profitability of six oil and gas firms. Findings reveal a pragmatic and notable effect for 10 years under the study. So also, Abdulrahman, Babangida & Mustapha, (2021), founds a positive and significant effects from environmental costs on the earnings of hydrocarbon companies in Nigeria.

Nwaimo (2020) investigated the effect of environmental costs on financial performance of firms in Sub-African Countries like Nigeria, Ghana, Tanzania

and South-Africa from 2007 to 2016. OLS revealed that environmental costs such as waste management, environmental detection, and employee health and safety had no discernible impact on earnings per share, return on equity, or return on capital employed. The study's overall findings indicate that, with the possible exception of Ghana and Tanzania, quoted firms in the region may not be doing enough to responsibly engage in the environment or to sufficiently disclose their environmental engagements to influence performance measures. The mixed results across different countries in Sub-Saharan Africa suggest regional variability in the impact of environmental costs. A more detailed exploration of country-specific factors and their influence on financial performance could enhance understanding.

Cletus, Nwite and Agana (2022) investigated the connection between the financial performance of a subset of Nigerian oil and gas companies and environmental accounting expenses from 2000 to 2020. This study focused on environmental accounting costs, including environmental detection costs (EDC), environmental pollution prevention costs (EPPC), environmental external failure costs (EEFC) and environmental internal failure costs (EIFC). The dependent variable was return on equity (ROE). Descriptive and inferential statistics were used to examine information from Conoil, MRS Oil, and Forte Oil's annual reports and financial statements. The findings showed that although EPPC and EDC had a negligible impact, EIFC and EEFC strongly and favorably impacted financial performance. The study found that environmental accounting expenses had a major effect on Nigeria's oil and gas sector's financial performance. The significant positive impact of certain environmental accounting costs on financial performance highlights their potential benefits. However, the negligible impact of other costs suggests variability in how different environmental expenses affect financial outcomes.

3. Methodology

3.1 Research Design

For this study, the ex-post facto research design was adopted. The use of non-manipulated data, which are already available and verifiable by the general public, justifies the adoption of this research approach. As a result, the researcher has no control or influence over the historical data used in the audited annual reports and accounts of oil and gas companies in Nigeria.

3.2 Method of Data Collection

The MachameRatios sustainability reports and corporate annual financial statements for the years 2013–2024 were used to source the data for this study. Due to the legal requirement that public companies be audited by a recognized auditing firm and that annual performance be reported to shareholders through the publication of annual statements of accounts, company annual statements, reports were considered to be reliable sources of data for this study. Hence, secondary method of data collection was utilized for this study.

3.3 Study Population

The study population includes all eight oil and gas companies listed on the Nigerian Exchange Group (NGX, 2024).

3.4 Sample Size and Sampling Technique

The purposive sampling technique was used to establish the study's sample size. The criteria used were that the oil and gas companies must be listed under Nigeria Exchange Group and has up-to-date environmental cost. Only six (6) Oil and Gas companies in Nigeria met these criteria were taken into consideration by this study which were; Eterna PLC, Conoil PLC, MRS Oil Nigeria PLC, Japaul Gold and Ventures PLC, Seplat Energy PLC, and Total Energies Marketing Nigeria PLC.

3.5 Technique of Data Analysis

Both descriptive and inferential statistics were employed in the study's data analysis. Panel Least Square (PLS) regression analysis and longitudinal (panel) regression were employed in this investigation using STATA software. The number of oil and gas businesses and the length of the investigation led to the adoption of panel data regression.

3.6 Model Specification

To have a valid and reliable model, this study adapted the model from Ihenyen and Ikegima (2022) in their work of environmental accounting and financial performance of listed industrial companies in Nigeria. The model was modified by incorporating variables such as environmental Pollution Prevention Cost, environmental Pollution Detection Cost and Community Development Cost to suit our study and are stated as follows:

In functional form, the model for this study was specified as:

ROCE = f(EPPC, EPDC, CDC) (3.1)

The econometric form of the model is explicitly specified as:

$ROCE = \beta_0 + \beta_1(EPPC)_{it} + \beta_2(EPDC)it + \beta_3(CDC)_{it} + \mu_{it}$ (3.2)

Where:

Dependent Variable:

ROCE = Return on capital employed

Independent Variable:

EPPC = environmental Pollution Prevention Cost

EPDC= environmental Pollution Detection Cost

CDC = Community Development Cost

μ_{it} = Error term of the regression equation (stochastic variable)

3.7 Method of Data Analysis

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4. Results and Discussion

4.1 Descriptive Analysis

Descriptive Analysis The descriptive statistics was used to explain or characterize data. The study's descriptive statistical analysis produced the following findings.

Table 4.1 Descriptive statistics

VAR	OBS	MIN	MAX	MEAN	STD	SKE	KUT	JB	P
ROCE	72	0.25	0.56	0.42	0.07	-0.06	0.11	2.16	0.24
CDC	72	1.22	20.53	14.86	2.96	-1.59	7.64	0.94	0.34
EPPC	72	0.00	1.00	0.85	0.36	-2.01	2.11	1.15	0.19
EPDC	72	0.00	1.00	0.66	0.48	-0.69	1.58	0.54	0.79
FMZ	72	1.15	19.90	14.66	3.56	-0.95	2.41	0.12	0.98

Table 1 showed that average ROCE of the listed Oil and Gas companies under study was 0.25 with standard deviation of 0.07 with minimum and maximum value of 0.25 and 0.56. The average community development cost of the listed Oil and Gas companies under study was 14.86 with standard deviation of 2.96. According to the result, the average environmental pollution prevention cost of the listed Oil and Gas companies under study was 0.85 with standard deviation of 0.36. The average environmental pollution detection cost of the listed Oil and Gas companies under study was 0.66 with standard deviation of 0.48. The average total asset of the listed Oil and Gas companies under study was 14.66 with standard deviation of 3.56. Furthermore, the coefficient of skewness revealed that all the variables under study skewed positively. as

regarding the kurtosis, while CDC was leptokurtic in nature (Kurtosis > 3), ROCE, EPPC, EPDC and FMZ were platykurtic in nature (kurtosis <3). The Jaque-bera statistic for the variables suggests that all the variables under consideration are normally distributed. Hence, the variables are expected to yield a reliable regression model. The varying levels of investment in environmental protection and community development imply that sustainability practices are increasingly integrated into business strategies, which can enhance cost management and profitability.

4.2 Correlation Analysis

Table 4.2: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)
ROCE (1)	1				
EPPC (2)	0.6463	1			
EPDC (3)	0.6123	0.4534	1		
CDC (4)	0.6321	0.3452	0.4112	1	
FMZ (5)	0.7121	0.3098	0.2343	0.1544	1

Table 2 shows that environmental pollution prevention cost (EPPC) is positively and strongly related with return on capital employed (ROCE) of the listed oil and gas companies in Nigeria within the period under consideration with correlation coefficient of 0.6463. Similarly, environmental pollution detection cost (EPDC), community development cost (CDC) and firms size (FMZ) were strongly and positively related with return on capital employed of the listed Oil and Gas companied in Nigeria. By implication, there is evidence of strong relationship between environmental accounting metrics and ROCE of the selected oil and Gas companies in Nigeria. Apart from that, the independent variables were observed not to be strongly related with each other, indicating that multicollinearity in the data set is likely not a concern. Thus, the coefficient for each independent variable under discussion reflects unique contribution of the variable to ROCE, holding other variables constant. Hence, the data are likely to provide a more stable regression model. The strong positive correlations between environmental and community investments (EPPC, EPDC, CDC) and financial performance (ROCE) imply that companies that focus on sustainability are likely to experience improved financial outcomes.

4.3 Hausman Test

Table 4.3: Hausman Test

Chi	DF	P
0.94653	3	0.3423

In order to determine which model is more suitable between random and fixed effect model, Hausman test was performed and the result presented in Table 3. The result of Hausman test showed the coefficient of Chi-square to be 0.94653 with corresponding probability value of 0.3423, suggesting superiority of random effect model over fixed effect model. This conclusion is supported by the insignificant Chi-square coefficient ($p<0.05$), leading to the retention of the null hypothesis that random effect model is suitable. The result from the Hausman test implies that the positive impact of sustainability practices on profitability is consistent across oil and gas companies, supporting the value of

integrating these practices into business models.

4.4 Regression Analysis

Table 4: Random Fixed Model

Variables	Coefficient	Standard Err	T	P
C	0.0564	0.0083	2.5291	0.0412
EPPC	0.2542	0.0321	7.919	0.0000
EPDC	0.1323	0.0223	5.933	0.0000
LOG(CDC)	0.2342	0.0365	6.4164	0.0000
LOG(FMZ)	0.3243	0.0353	9.4674	0.0000
R-sq	0.8233	AIC		-32123
Adj R-sq	0.7865	BIC		-24323
F	43.4323	HQC		-29863
P	0.0000	D-Watson		2.1212

Table 4 present the result of random effect model for examining the impact of environmental accounting on profitability of oil and gas companies in Nigeria. The result revealed that, the estimated model produced R-square of 0.8233, indicating that environmental pollution prevention cost, environmental pollution detection, community development cost and firm's size accounted for 82.3 per cent of total variation in return on capital employed of the selected Oil and Gas companies in Nigeria while the remaining 17.7 per cent of the variation in ROCE could be attributed to other variable not in the model. The adjusted R-square of 0.7865 indicates that the predictive power of the estimated random effect model is strong, further supporting the non-spurious of the model. The F-statistic was 43.4323 with probability value of 0.0000, suggesting that overall model statistically significant at 5 per cent. Hence, environmental pollution cost, environmental pollution detection, community development cost and firm's size collectively and significantly impacted the Return on capital employed (ROCE) of the selected Oil and Gas companied within the period under consideration.

The Dublin Watson coefficient of 2.1212 was found to be within the acceptable range of 1.5 to 2.4, suggesting that estimated random effect model has no autocorrelation problem. Hence the mode is desirable and acceptable. The coefficient of environmental pollution prevention cost (EPPC) was 0.2542 ($p<0.05$), indicating that EPPC has a positive significant impact on ROCE of the listed Oil and Gas firms in Nigeria. Thus, a unit increase in EPPC, result to 0.25 increase in ROCE of the oil and Gas firms under review. The coefficient of environmental pollution detection cost (EPDC) was 0.1323 ($p<0.05$), indicating that EPDC has a positive significant impact on ROCE of the listed Oil and Gas firms in Nigeria. Thus, a unit increase in EPPC, result to 0.13 increase in ROCE of the Oil and Gas firms under review. The coefficient of community development cost (CDC) was 0.2342 ($p<0.05$), indicating that CDC has a positive significant impact on ROCE of the listed Oil and Gas firms in Nigeria. Thus, a unit increase in CDC, result to 0.23 increase in ROCE of the Oil and Gas firms under review. The coefficient of firm size (FMZ) was 0.3243 ($p<0.05$), indicating that FMZ has a positive significant impact on ROCE of the listed Oil and Gas firms in Nigeria. Thus, a unit increase in CDC, result to 0.32 increase in ROCE of the Oil and Gas firms under review. The significant positive relationship between environmental costs (EPPC, EPDC, CDC) and ROCE implies that oil and gas

companies that invest in sustainability practices see a notable improvement in financial returns, especially larger firms.

Discussion

Having examined the impact of environmental accounting on return on capital employed of the listed Oil and Gas companies in Nigeria. The result revealed that all the metrics of environmental accounting (environmental pollution prevention cost, environmental pollution detection cost, community development cost) used for this study positively and significantly impacted return on capital employed of the selected Oil and Gas companied under study. This implies that investing in environmental protection and detection as well as community development improves and enhance the profitability of selected Oil and Gas companies in Nigeria. This is supported by Okonkwa (2021) asserting that firms that priorities environmental accounting, benefit improved firm reputation, operational efficiency which by extension improved the profitability of the company. However, this finding is consistent with the study of Nwaiwu and Oluka (2018), revealing a positive and significant impact of environmental pollution prevention cost, environmental pollution detection cost, community development cost disclosure on financial performance of oil and gas companies in Nigeria. Integrating sustainability practices into business strategies implies that oil and gas companies can enhance both their corporate social responsibility efforts and profitability, making it a beneficial approach in the Nigerian context.

5. Conclusion and Recommendations

Conclusion

This study empirically revealed that investment in environmental pollution prevention cost, environmental pollution detection and community development significantly improves the return on capital employed for oil and gas firms ($F=43.4323$, $p=0.000$), demonstrating the potentials sustainable practices has in improving firm's profitability. In conclusion, by putting into consideration environmental stewardship and community development engagement, Oil and Gas companies in Nigeria not only mitigate risk associated with environmental liabilities but also facilitate a positive firm reputation and image and build strong relationship with stakeholders, resulting to improved profitability.

Recommendations

Based on the findings and conclusion, the following recommendations are suggested:

1. Given that environmental pollution prevention cost, environmental pollution detection cost and community development cost have positive and significant impact on ROCE of Oil and Gas companies, it is recommended that more resources should be allocated by Oil and Gas toward pollution prevention and detection as well as community development programs to continue fostering firm reputation and goodwill.
2. There is the need to priorities environmental pollution prevention cost, environmental pollution detection cost and community development cost disclosure within the company's financial reporting practices. This will go a long way in enhancing their standing among investors and stakeholders such as customers who place values on sustainability and ethical business conducted.

Oil and Gas companies should ensure that they comply with the environmental laws and regulation of the country as it will go a long way in improving their financial performance, particularly return on capital employed. Also, propagation of environmental awareness within the host community should be encouraged as this will go a long way in building good relationship between Oil and gas companies and the host communities.

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