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CARBON MANAGEMENT AND FINANCIAL PERFORMANCE OF QUOTED OIL AND GAS FIRMS IN NIGERIA

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Key words: *Carbon Emission Management, Return on Assets, Transport Emission Management, Waste Disposal Management.*

ABSTRACT

This study ascertained the effect of carbon management on financial performance of listed oil and gas firms in Nigeria for a period of sixteen (16) years spanning from 2008 to 2023. Specifically, this study examined the effect of carbon emission management, waste disposal management and transport emission management on return on assets. The panel data sets used in this study were obtained from the annual reports and accounts and Nigerian Exchange (NGX) Group fact books for the study period. Ex-post facto research design was employed. The study is anchored on stakeholder theory. Descriptive statistics of the data set was employed to describe the variables using the mean, standard deviation, minimum and maximum values of the data for the study variables. Inferential statistics using Correlated Random Effects and Panel Least Square Regression analysis were applied to test the hypotheses of the study. Data analysis revealed that: carbon emission management has a positive and significant effect on ROA of listed oil and gas firms in Nigeria (β = 1.6036, p = 0.0117); waste disposal management has a positive and significant effect on ROA of listed oil and gas firms in Nigeria (β = 1.4944, p = 0.0153); transport emission management has a positive and significant effect on ROA of listed oil and gas firms in Nigeria (β = 0.0644, p = 0.0313). In conclusion, efficient emissions control, waste management, and transport optimization, contributes directly to profitability, reinforcing the notion that sustainability and financial success are interconnected in today's business environment. The study recommends that managers in oil and gas firms should implement comprehensive carbon emission reduction strategies, including the adoption of cleaner technologies and energy-efficient equipment.

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1. INTRODUCTION

Climate change is one of the most complex environmental issues posing threats and providing opportunities for companies in all sectors. From a business point of view, corporate attitudes towards climate change have changed significantly in recent times. In the early 1990s, businesses are often found to cover up or ignore climate change issues. Over time, the goal of business has changed from an emphasis on shareholder satisfaction alone towards mutual benefits for business and societies (Okafor, Nworie & Onyebuchi, 2024; Anaike, Nworie & Ochuka, 2024; Nworie & Orji-Okafor, 2024). Companies, as part of society, are now faced with the challenge of how to reduce their adverse environmental impacts (Ukoh, Nduokafor & Nworie, 2024) including emissions to mitigate climate change. In addition, they are concerned with how climate change will impact upon their operations, since the increase in atmospheric temperature has given rise to an accumulation of greenhouse gas (GHG) emissions, especially of carbon dioxide.

The political context in which different countries have different positions concerning the future of international climate policies exposes companies to a very high level of regulatory uncertainty (Amahalu & Moedu, 2023; Okafor, 2018). In the absence of a global regulatory framework for climate change, many firms now consider a climate strategy, a vital business practice for competitive reasons. Furthermore, even in the absence of government regulation, numerous firms have decided to constrain their impact on the global climate and publicly adhere to a specific carbon norm, such as carbon neutrality or carbon labels, to show their commitment to climate change mitigation on a voluntary basis or in response to stakeholder pressure from investors, suppliers, or consumers. As a consequence, an increasing number of firms around the world carefully consider create and implement carbon management strategy to mitigate carbon emissions. Carbon Management Strategy enables a company to identify its carbon emissions sources, measure its emissions inventory, and explore alternative options to cut its emissions levels (Okudo & Amahalu, 2023).

Given that carbon emissions are still largely unregulated the question is why many companies voluntarily commit resource to cut emissions and disclose carbon information. Some extant literatures often use a win-win situation to justify voluntary corporate social responsibility (CSR) activities, that is, firms take CSR because it can help achieve financial goals, but empirical research has failed to provide consistent evidence. Growing scientific evidence shows that carbon management is a serious challenge and uncontrolled global warming will cause enormous damage. However, corporate responses are ambiguous and mixed. Some

studies show that carbon emission and financial performance are negatively associated (for example, Wang, Liu & Qin, 2022), whereas others find a positive relationship between carbon emission and financial performance (for example, Amahalu & Okudo, 2023; Liu, Kim, Lee & Yoo, 2022). There are also studies which arrive at a neutral effect (for example, Naciti and Giovanna, 2022). It is in this light that the current study is undertaken to examine the effect of carbon management on financial performance of quoted oil and gas firms in Nigeria.

1.1 Objectives

The broad objective of this study is to ascertain the effect of Carbon Management on Financial Performance of listed Oil and Gas firms in Nigeria. Specifically, this study:

1. examines the effect of Carbon Emission Management on Return on Assets of listed Oil and Gas firms in Nigeria
2. investigates the effect of Waste Disposal Management on Return on Assets of listed Oil and Gas firms in Nigeria
3. determines the effect of Transport Emission Management on Return on Assets of listed Oil and Gas firms in Nigeria

1.2 Hypotheses

The following research hypotheses were developed in a null form:

H_{o1}: Carbon Emission Management has no significant effect on Return on Assets of listed Oil and Gas firms in Nigeria

H_{o2}: Waste Disposal Management has no significant effect on Return on Assets of listed Oil and Gas firms in Nigeria

H_{o3}: Transport Emission Management has no significant effect on Return on Assets of listed Oil and Gas firms in Nigeria

2. LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Carbon Management

Carbon management technologies aim to manage anthropogenic releases of greenhouse gases, such as those associated with the combustion of fossil fuel use, in an effort to mitigate the potential impacts of these emissions on climate systems. Carbon management is a systematic, organisation-wide approach to reducing carbon emissions, integrating the technical, regulatory, financial, corporate governance and communications aspects within an

overarching strategy and plan of action. Its principal aim is to help a client adapt to an increasingly carbon-constrained economy. An effective carbon management approach will seek to define and maximise strategic opportunities as well as develop a tactical plan to limit liabilities. (Mbonu & Amahalu, 2022; Wang, Geng, & Xia, 2021).

2.1.2 Carbon Emission Management

Carbon emission management is a systematic, organisation-wide approach to reducing carbon emissions, integrating the technical, regulatory, financial, corporate governance and communications aspects within an overarching strategy and plan of action (Verma, Schmidt Vogt, De Alban, Lim & Webb, 2021). It is an economical method of reducing green house gas (GHG) emissions is to reduce energy consumed. Carbon emission management means energy conservation or efficiency measures, reducing gas flaring and managing the emissions of methane. It is a wide variety of policy and legal drivers which require businesses to measure and understand their energy consumption and greenhouse gas emissions (Udo, Oraka & Amahalu, 2022).

2.1.3 Waste Disposal Management

Waste disposal management refers to all actions carried out and the facilities put in place to ensure proper disposal of human, plant, animal, other forms of residual to promote health, personal hygiene and sanitation in schools and the community. Waste disposal management refers to disposal, processing, controlling, recycling, and reusing the solid, liquid, and gaseous wastes of plants, animals, humans, and other organisms which can include control within a closed ecological system to maintain a habitable environment (Okafor, Egbunike & Amahalu, 2022). Waste disposal management refers to the various schemes to manage and dispose of wastes which can be by discarding, destroying, processing, recycling, reusing, or controlling wastes. The prime objective of waste management is to reduce the amount of unusable materials and to avert potential health and environmental hazards (Dogan & Güler 2021).

2.1.4 Transport Emission Management

Transport emission management means the process of reducing GHGs from transportation: increasing the efficiency of vehicle technology and using lower-carbon fuels. Transport emission management help in the reduction of passenger-car CO2 emissions by improving engine efficiency, promoting hybridization or electrification of cars, and facilitating traffic flow by adopting ITS (intelligent transport systems). Transport emission management is the

most economical method of reducing GHG emissions by reducing energy consumed (Yu, Shi, Guo & Yang, 2021).

2.1.5 Financial Performance

Financial performance is the achievement of the company's financial performance for a certain period covering the collection and allocation of finance measured by capital adequacy, liquidity, solvency, efficiency, leverage and profitability. Financial performance is the quantitative measure of how well a company uses its business assets and generates revenues which can also refer to the company's overall financial health over a given period (Amahalu & Obi, 2020b). Financial performance can be the level of performance of a business over a specified period of time, expressed in terms of overall profits and losses during that time

2.1.6 Return on Assets (ROA)

Return on assets is a profitability ratio that provides how much profit a company is able to generate from its assets. In other words, return on assets (ROA) measures how efficient a company's management is in generating earnings from their economic resources or assets on their statement of financial position (Amahalu & Obi, 2020a). Return on assets (ROA) measures a company's profitability relative to its total assets. It shows how well (or poorly) a company is using everything it owns from machinery to vehicles and intellectual property to earn money.

2.1.7 Carbon Management and Financial Performance

Prior literature investigates the impact of carbon emissions on various attributes of firms. For instance, Weber (2017) examined the impact of firms' carbon emissions on the cost of bank debt financing and found a positive association between them. In a similar fashion, Ekweozor, Ogbodo and Amahalu, (2022); Okafor, (2013) found consistent evidence that higher carbon emissions have a positive and significant effect on the cost of bank debt financing. Similarly, Okudo and Ndubuisi (2021) show that firms' carbon emissions reduce equity value. Ezeokafor and Amahalu (2019) provide evidence that carbon emissions increase firms' credit risk, which, in turn, lowers the credit rating of carbon-intensive firms. Firms' carbon reduction also helps boost their financial return. Conversely, Liu, Kim & Yoo (2019); Okudo, Ezechukwu and Amahalu (2022) show a negative impact of carbon emissions on firms' financial performance.

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2.2 Theoretical Framework

2.2.1 Stakeholder Theory

In 1984, R. Edward Freeman originally detailed the Stakeholder Theory of organizational management and business ethics that addresses morals and values in managing an organization. His award-winning book Strategic Management: A Stakeholder Approach identifies and models the groups which are stakeholders of a corporation, and both describes and recommends methods by which management can give due regard to the interests of those groups. Dr. Freeman suggests that a company's stakeholders are those groups without whose support the organization would cease to exist. These groups would include customers, employees, suppliers, political action groups, environmental groups, local communities, the media, financial institutions, governmental groups, and more. This view paints the corporate environment as an ecosystem of related groups, all of whom need to be considered and satisfied to keep the company healthy and successful in the longterm (Freeman, 2004).

2.3 Empirical Review

Ironkwe and Ordu (2016) examined environmental reporting in the oil and gas industry in Nigeria from 2009-2014 using multiple regression. The regression result showed that there is a positive and significant relationship between environmental disclosure and return on assets of oil and gas firms in Nigeria.

Nnamani, Onyekwelu and Ugwo (2017) evaluated the effect of sustainability accounting on the financial performance of listed manufacturing firms in Nigeria 2009-2016. Data were analysed using the ordinary linear regression. The study revealed that sustainability reporting has positive and significant effect on financial performance of firms studied.

Lee and Cho (2021) examined the effect of carbon emissions and carbon disclosures on firm-value with evidence from Korea firms 2013 to 2017. Using hand-collected carbon emissions and firm-specific data for 841 Korean firms, including 514 chaebols and 335 non-chaebols, the study found a significantly positive relationship between carbon emissions and firm value among chaebol affiliates.

Oikonomou, Polemis and Soursou (2021) carried out a study on the effect of carbon emission on economic growth of Greece from 2010-2019. The study conducted an ARDL approach employing dynamic panel data techniques. The empirical analysis supported that the reduction in CO2 emissions can be achieved without a slowdown in economic activity for the sample country.

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Jiachen, Huasheng and Fei (2021) carried out an investigation whether industrial transfer change the spatial structure of CO2 emissions, evidence from Beijing-Tianjin-Hebei Region in China from 2002 to 2017 using fixed effect panel regression. The results obtained indicated that industrial transfer-in has promoted CO2 emissions to a small extent, and the positive impact of industrial transfer-in on CO2 emissions wanes over time.

Jeong-Hwan and Jin-Hyung (2021) examined the effect of carbon emissions and carbon disclosures on firm-value with evidence from Korea firms 2013 to 2017. Using hand-collected carbon emissions and firm-specific data for 841 Korean firms, including 514 chaebols and 335 non-chaebols, the study found a significantly positive relationship between carbon emissions and firm value among chaebol affiliates.

3. MATERIAL AND METHOD

Ex-post facto research design was employed in this study. The population of the study consisted of all the twelve (12) Oil and Gas firms listed on the Nigerian Exchange (NGX) Group as at 31st December, 2023. They are: 11 Plc (formerly Mobil Plc), Anino International Plc; Capital Oil Plc; Conoil Plc; Eterna Plc; Forte Oil Plc; Japaul Oil & Maritime Services Plc; MRS Oil Nigeria Plc; Oando Plc; Rak Unity Plc; Seplat Petroleum Development Company Plc; Total Nigeria Plc. The sample size of this study comprised ten (10) listed Oil and Gas firms that have consecutively submitted their annual reports to the Nigerian Exchange (NGX) Group from 2008 to 2023. Purposive sampling technique was adopted to select the companies with up to date and complete annual reports and accounts for the study period (2008-2023). The criteria for the sample selection include: companies that publish their annual reports and sustainability reports from 2008-2023, and as well as companies that implicitly or explicitly disclose carbon emissions; companies that have been actively trading consistently on the floor of the Nigerian Exchange (NGX) Groupfor the period of interest. They include: Anino International Plc; Capital Oil Plc; Conoil Plc; Eterna Plc; Japaul Oil & Maritime Services; MRS Oil Nigeria Plc; Oando Plc; Rak Unity Plc; Seplat Petroleum Development Company Plc; Total Nigeria Plc. The data to be used in this study was collected mainly from secondary source. These data were obtained from sixteen (16) years annual reports and account from 2008-2023 of the sample Oil and Gas firms.

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Table 1 Variable Description

Variable	Proxies	Acronym	Measurement
Carbon Management (Independent Variable)			
	Carbon Emission Management	CED	Total Carbon Emission Score Disclosed / Maximum Number of Carbon Emission Score that a firm could Disclose
	Waste Disposal Management	WDM	Total Waste Disposal Score Disclosed / Maximum Number of Waste Disposal Score that a firm could Disclose
	Transport Emission Management	TEM	Total Transport Emission Score Disclosed / Maximum Number of Transport Emission Score that a firm could Disclose
Financial Performance (Dependent Variable)			
	Return on Assets	ROA	Net Income / Total Assets

Volume of Carbon Emission Management, Waste Disposal Management and Transport Emission Management was measured by content analysis to find the degree of volume of carbon management that was disclosed in Sustainability Reports. Disclosure of Carbon Disclosure Practice is measured by scoring a maximum score of 18 (see appendix A) and the minimum score is 0. Each item is worth 1 if the company discloses all of the information in the report so that mean company score is 18. Score on each company then totaled and divided by 18. The Carbon Management Disclosure checklist, adapted from Global Reporting Initiative standards can be seen in appendix 1. A non-weighted (binary) index was devised to examine the narrative sections of the annual and stand-alone sustainability reports (for example, chairman or director's statement, review of sustainability activities and discussions) for each entity. If the entity disclosed a certain item at least once, the score was assigned as 1, and 0 otherwise. Hence, Carbon Disclosure Index (CDI), including 18 items, was identified

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to measure the extent of carbon disclosures provided by the entities. The carbon disclosure score will be calculated by dividing the items disclosed to a maximum number of items that a firm could disclose. The total CDI score was calculated as:

$$CDI = \frac{\text{Items disclosed}}{\text{Maximum number of items that a firm could disclose}}$$

The model of this study was adapted from Lu, Zhu and Zhang (2021):

$ROE = \beta o + \beta_1 CEMD_{it} + \beta_2 APMD_{it} + \beta_3 FCMD_{it} + \mu_{it}$ - - - Eqn 1.

Where :

ROE = Return on Equity

CEMD = Carbon Emission Management Disclosure

APMD = Air Pollution Management Disclosure

FFCMD = Fossil-Fuel Combustion Management Disclosure

Consequent upon the adapted model, the following multiple regression equation was costructed:

$ROA_{it} = \beta o + \beta_1 CEMD_{it} + \beta_2 WDMD_{it} + \beta_1 TEMD_{it} + \mu_{it}$ - - - Eqn 2.

Where:

β_o = Constant term (intercept)

β_{it} = Coefficients of Carbon Management to be estimated for firm i in period t

μ_{it} = Error term/unexplained variable(s) of firm i in period t

CED_{it} = Carbon Emission Management Disclosure of firm i in period t

WDM_{it} = Waste Disposal Management Disclosure of firm i in period t

TEM_{it} = Transport Emission Management Disclosure of firm i in period t

ROA_{it} = Return on Assets of firm i in period t

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4. RESULT AND DISCUSSIONS

4.1 Data Analysis

Table 2 Descriptive Statistics

	ROA	CED	WDM	TEM
Mean	0.812698	0.084375	0.054188	0.039813
Median	0.760000	0.065000	0.050000	0.030000
Maximum	3.400000	0.780000	0.200000	0.530000
Minimum	-0.995525	0.000000	0.010000	0.000000
Std. Dev.	0.748110	0.082276	0.027643	0.065603
Skewness	0.622645	4.246209	1.623393	5.206744
Kurtosis	3.208606	33.63441	7.675664	33.39193
Jarque-Bera	10.62841	6737.255	216.0230	6880.734
Probability	0.004921	0.000000	0.000000	0.000000
Sum	130.0317	13.50000	8.670000	6.370000
Sum Sq. Dev.	88.98730	1.076338	0.121494	0.684294
Observations	160	160	160	160

Source: E-Views 10.0 Descriptive Output, 2024

Table 2 shows that the mean value of ROA is 0.8127, indicating that, on average, oil and gas firms generate a return of 81.27% on their assets over the 16-year period. The maximum ROA observed is 3.40, suggesting that some firms achieved very high profitability, while the minimum value is -0.9955, indicating negative returns for certain firms in some years, possibly due to operational losses. The standard deviation of 0.7481 shows moderate variability in financial performance across the firms. The skewness value of 0.6226 suggests a slight positive skew, indicating that most firms had ROA values below the mean, with a few outliers on the higher side. The kurtosis of 3.2086 is close to the benchmark for a normal distribution (3), meaning the data has a relatively normal shape with mild outliers. However, the Jarque-Bera probability of 0.0049 is statistically significant, indicating that the ROA distribution deviates from normality.

The mean value of Carbon Emission Management (CED) is 0.0844, suggesting that firms, on average, disclosed 8.44% of the maximum possible carbon emission score. The maximum score of 0.78 indicates that the highest level of disclosure by any firm was 78% of the total possible, while some firms disclosed no carbon emission information (minimum value of 0). The standard deviation of 0.0823 shows that the carbon emission disclosure levels vary

significantly across firms. The skewness value of 4.2462 indicates a highly positive skew, meaning most firms disclosed low emission scores, with a few reporting higher values. The kurtosis of 33.6344 points to extreme leptokurtosis, suggesting a high concentration of observations near the lower end, with significant outliers at the upper end. The Jarque-Bera probability of 0.0000 confirms that the CED data distribution is non-normal.

The mean value for Waste Disposal Management (WDM) is 0.0542, indicating that firms disclosed 5.42% of the maximum possible waste disposal score on average. The maximum value observed is 0.20, meaning the best-performing firm reported 20% of the full score, while the minimum disclosure is 0.01. The standard deviation of 0.0276 indicates low variability in waste management disclosures across firms. The skewness value of 1.6234 suggests a positive skew, with more firms clustering towards lower values. The kurtosis of 7.6757 shows that the data is leptokurtic, with observations concentrated around the mean and some extreme values. The Jarque-Bera probability of 0.0000 indicates the WDM data is not normally distributed.

The mean of Transport Emission Management (TEM) is 0.0398, implying that firms disclosed, on average, 3.98% of the maximum possible transport emission score. The highest observed value is 0.53, indicating a few firms provided detailed disclosures, while some firms did not report any transport emission data (minimum value of 0). The standard deviation of 0.0656 suggests moderate variability in the disclosure levels. The skewness value of 5.2067 indicates a significant positive skew, with most firms reporting very low scores, and a few disclosing much higher scores. The kurtosis of 33.3919 indicates an extremely peaked distribution, reflecting the presence of heavy tails with significant outliers. The Jarque-Bera probability of 0.0000 confirms that the TEM data is far from normally distributed.

4.2 Test of Hypotheses

The hypotheses were tested using estimates from the fixed effect panel regression as suggested by the Hausman specification test.

Table 3 Panel Least Square Regression Analysis

Dependent Variable: ROA

Method: Panel Least Squares

Date: 10/17/24 Time: 06:02

Sample: 2008 2023

Periods included: 16

Cross-sections included: 10

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Total panel (balanced) observations: 160

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CED	1.603648	0.627342	2.556257	0.0117
WDM	1.494385	1.828656	2.817204	0.0153
TEM	0.064363	0.744698	3.086428	0.0313
C	0.760930	0.119266	6.380106	0.0000
	Effects Specification			
Cross-section fixed (dummy variables)				
Period fixed (dummy variables)				
R-squared	0.537681	Mean dependent var		0.812698
Adjusted R-squared	0.443116	S.D. dependent var		0.748110
S.E. of regression	0.558275	Akaike info criterion		1.829697
Sum squared resid	41.14051	Schwarz criterion		2.367852
Log likelihood	-118.3757	Hannan-Quinn criter.		2.048223
F-statistic	5.685823	Durbin-Watson stat		1.386985
Prob(F-statistic)	0.000000			

Source: E-Views 10 Correlation Output, 2024

The results from the panel regression, as indicated in Table 3 above shows the R-squared value of 0.5377. This means that 53.77% of the variation in ROA is explained by the independent variables: carbon emission management (CED), waste disposal management (WDM), and transport emission management (TEM). The Prob(F-statistic) of 0.0000 indicates that the model as a whole is statistically significant. The Durbin-Watson statistic of 1.387 suggests some level of positive serial correlation, but the model remains robust for interpretation.

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4.2.1 Hypotheses I

H_{o1}: Carbon Emission Management has no significant effect on Return on Assets of listed Oil and Gas firms in Nigeria

The coefficient of carbon emission management (CED) is 1.6036, with a p-value of 0.0117. This positive and significant effect implies that for every unit increase in carbon emission management practices, the ROA increases by 1.60 units on average, holding other factors constant. This suggests that firms actively managing and disclosing carbon emissions benefit from improved operational efficiency, regulatory incentives, or enhanced market reputation, which positively impacts financial performance. The alternate hypothesis was accepted since the p-value (0.0117) is less than 0.05. Thus, carbon emission management has a positive and significant effect on ROA of listed oil and gas firms in Nigeria ($\beta = 1.6036$, $p = 0.0117$).

The study revealed a positive and significant effect of carbon emission management (CED) on ROA ($\beta = 1.6036$, $p = 0.0117$). This result suggests that firms that actively manage and disclose their carbon emissions benefit from improved financial performance. A plausible reason is that investors and stakeholders are increasingly concerned about environmental responsibility, and firms with transparent carbon management are perceived as sustainable and future-ready, which attracts more investment. Additionally, such firms may benefit from government incentives, tax credits, or subsidies linked to environmental compliance. Carbon emission management can also reduce operational inefficiencies, such as energy wastage, leading to cost savings. Consequently, improved environmental practices translate into higher profitability for firms in the oil and gas sector. The positive effect of carbon emission management on ROA aligns with several studies that emphasize the importance of carbon management strategies in enhancing corporate financial performance. For instance, Apergis and Ozturk (2015) found a significant positive relationship between carbon management and GDP across 14 Asian economies, suggesting that effective carbon management not only supports environmental goals but also enhances economic performance at a broader scale. Similarly, Alhashi, Nobanee, and Khare (2018) reported a positive relationship between corporate sustainability practices and ROA, indicating that firms that proactively manage their carbon emissions tend to experience better financial outcomes. Furthermore, the findings from Tuesta, Soler, and Feliu (2020) highlight that carbon management affects profitability, particularly in terms of ROA, reinforcing the notion that strategic management of carbon emissions can yield significant financial benefits for firms. In contrast, the study by Saka (2018), which indicated a negative relationship between carbon emissions and market value,

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suggests that while carbon management can enhance ROA, excessive emissions without effective management could be detrimental to firm valuation.

4.2.2 Hypotheses II

H_{o2}: Waste Disposal Management has no significant effect on Return on Assets of listed Oil and Gas firms in Nigeria

The coefficient of waste disposal management (WDM) is 1.4944, with a p-value of 0.0153. This indicates a positive and significant effect at the 5% level. For each unit increase in waste disposal management efforts, ROA increases by 1.49 units on average. This result suggests that improved waste management practices can reduce costs associated with environmental penalties and waste inefficiencies, leading to better financial performance. The alternate hypothesis was accepted since the p-value (0.0153) is less than 0.05. Thus, waste disposal management has a positive and significant effect on ROA of listed oil and gas firms in Nigeria ($\beta = 1.4944$, $p = 0.0153$).

The findings indicate that waste disposal management (WDM) has a positive and significant effect on ROA ($\beta = 1.4944$, $p = 0.0153$). Proper waste management practices can reduce the environmental risks and liabilities associated with hazardous waste, which in turn helps firms avoid fines and penalties. Effective waste disposal also signals good corporate governance, which enhances the firm's reputation and builds stakeholder trust. Additionally, firms that recycle or properly manage waste may convert waste streams into revenue-generating opportunities, such as selling by-products. This finding aligns with the growing emphasis on the circular economy, where waste reduction strategies drive both environmental and financial performance. In addition to carbon emission management, waste disposal management's positive effect on ROA finds support in existing literature that underscores the relevance of effective waste management strategies in improving financial performance. Nwaiwu and Oluka (2018) found a positive significant effect of environmental cost disclosure on return on capital employed (ROCE), suggesting that firms that manage their waste effectively are likely to report better financial outcomes. Furthermore, Obara and Nangih (2017) revealed a significant relationship between environmental accounting practices and profitability measures, including ROA, which supports the argument that diligent waste management correlates with improved financial performance. Moreover, Ironkwe and Ordu (2016) found a negative relationship between environmental reporting and ROA; however, this could indicate that while some forms of reporting may not directly translate to improved ROA,

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effective waste management practices can enhance operational efficiency and contribute positively to profitability.

4.2.3 Hypotheses III

H_{o3}: Transport Emission Management has no significant effect on Return on Assets of listed Oil and Gas firms in Nigeria

The coefficient of transport emission management (TEM) is 0.0644, with a p-value of 0.0313, which is significant at the 5% level. This result shows that for every unit increase in transport emission management, ROA improves by 0.064 units on average. Although the magnitude of the effect is smaller than that of CED and WDM, it still suggests that managing transport-related emissions contributes positively to financial performance, likely through fuel savings, better logistics, and regulatory compliance. The alternate hypothesis was accepted since the p-value (0.0313) is less than 0.05. Thus, transport emission management has a positive and significant effect on ROA of listed oil and gas firms in Nigeria ($\beta = 0.0644$, $p = 0.0313$).

The positive and significant effect of transport emission management (TEM) on ROA ($\beta = 0.0644$, $p = 0.0313$) highlights the importance of managing transport-related emissions. Although the effect size is smaller than that of CED and WDM, it reflects the benefits of optimizing logistics and reducing fuel consumption. Many oil and gas firms operate large fleets, and by managing emissions, they can reduce fuel costs and enhance operational efficiency. Additionally, compliance with transport emission standards reduces the risk of legal sanctions and reputational damage. Consumers and business partners increasingly prefer environmentally responsible companies, further incentivizing firms to adopt greener transportation practices. Although the effect is modest, it demonstrates that even incremental improvements in transport emissions can enhance financial outcomes. Lastly, the finding that transport emission management positively affects ROA is supported by research that highlights the broader economic benefits of sustainable transport practices. Odukoya and Akinsola (2021) found that improved environmental performance leads to increased efficiency, thus enhancing financial outcomes. This aligns with the findings of Jeong-Hwan and Jin-Hyung (2021), who noted a positive relationship between carbon emissions disclosures and firm value, suggesting that effective management of transport emissions can translate into better financial results. Ironkwe and Ordu (2016) also noted a significant relationship between environmental performance and financial metrics, which implies that

managing transport emissions could be an integral part of a firm's overall strategy for improving ROA.

CONCLUSION AND RECOMMENDATIONS

This study investigated the effect of carbon management practices on the financial performance of listed oil and gas firms in Nigeria, focusing on three dimensions: carbon emission management (CED), waste disposal management (WDM), and transport emission management (TEM). The financial performance was measured using return on assets (ROA), and the findings indicate that carbon management efforts positively influence firms' profitability.

The findings of this study highlight the strategic importance of integrating carbon management practices into the core operations of oil and gas firms. The significant positive impact of carbon emission management (CED) on financial performance suggests that firms can benefit from aligning their operations with environmental sustainability. This implies that environmental transparency and responsible practices are no longer optional but integral to driving profitability in the industry. As stakeholders increasingly favor companies with sustainable practices, carbon management may serve as a differentiating factor, providing competitive advantages in capital markets and improving investor confidence.

The positive effect of waste disposal management (WDM) on return on assets (ROA) emphasizes the financial value of responsible waste handling. This finding implies that effective waste management does not merely reduce environmental risks but also enhances financial outcomes by minimizing regulatory costs and improving corporate reputation. Moreover, it reflects how environmental stewardship can create new opportunities, such as resource recovery and waste monetization. The result underscores the growing relevance of the circular economy in shaping the financial landscape, suggesting that firms with better waste management strategies can enhance their market standing and financial stability.

The significant but modest effect of transport emission management (TEM) implies that even smaller improvements in logistical efficiency can positively impact financial performance. This suggests that managing transport emissions is not only environmentally beneficial but also economically valuable, especially in industries like oil and gas, where fleet operations are substantial. By controlling transport emissions, firms can mitigate regulatory risks, avoid

fines, and improve operational efficiency through fuel savings. These findings indicate that environmental initiatives, even in operational aspects like transportation, contribute meaningfully to financial performance, reinforcing the broader trend of sustainability becoming essential to business success. Therefore, efficient emissions control, waste management, and transport optimization, contributes directly to profitability, reinforcing the notion that sustainability and financial success are interconnected in today's business environment.

Thus, the study recommends that:

a. Managers in oil and gas firms should implement comprehensive carbon emission reduction strategies, including the adoption of cleaner technologies and energy-efficient equipment. They should also ensure regular monitoring and transparent disclosure of emission data to build investor trust and align with global environmental standards, thereby sustaining financial performance over the long term.

b. Operations managers should develop advanced waste management frameworks that go beyond mere compliance with regulations, focusing on waste minimization, recycling, and resource recovery. Collaborating with environmental agencies and third-party recyclers can further optimize waste management practices, reduce operational costs, and improve financial outcomes by turning waste into valuable resources.

c. Fleet managers should adopt sustainable transport policies, including investing in low-emission or electric vehicles and utilizing digital tools for real-time route optimization to minimize fuel consumption. Additionally, partnering with suppliers and logistics providers committed to sustainable practices will further enhance environmental compliance and operational efficiency, leading to better financial performance

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APPENDIX A

Table 4: Carbon Management Disclosure Checklist

Climate Change: risks and opportunities	CC1- Assessment/description of the risks (regulatory, physical or general) relating to climate change and actions taken or to be taken to manage the risks
	CC2- Assessment/description of current (and future) financial implications, business implications and opportunities of climate change
GHG Emission	GHG1- Description of the methodology used to calculate GHG emissions (e.g. GHG protocol or ISO)
GHG Emission	GHG2- Existence external verification of quantity of GHG emission- if so by whom and on what basis
	GHG3- Total GHG Emissions – metric tons CO2-e emitted
	GHG4- Disclosure of scopes 1 and 2, or scope direct GHG emissions
	GHG5- Disclosure of GHG emissions by sources (e.g. coal, electricity, etc.)
	GHG6- Disclosure of GHG emissions by facility or segment level
	GHG7- Comparison of GHG emissions with previous years
Energy Consumption	EC1- Total energy consumed (e.g. tera-joules or peta-joules)
	EC2- Quantification of energy used from renewable sources
	EC3- Disclosure by type, facility or segment
GHG Reduction and Cost	RC1- Detail of plans or strategies to reduce GHG emissions
	RC2- Specification of GHG emissions reduction target level and target year
	RC3- Emissions reductions and associated costs or savings
	RC4- Cost of future emissions factored into capital expenditure planning
Carbon Emission Accountability	AEC1- Indication of which board committee (or other executive body) has overall responsibility for actions related to climate change
	AEC2- Description of the mechanism by which the board (or other executive body) reviews the company's progress regarding climate change

Source: Global Reporting Initiative Standards, 2023