**IMPACT ASSESSMENT OF CARBON MANAGEMENT ACCOUNTING ON PERFORMANCE OF LISTED MANUFACTURING FIRMS IN NIGERIA**

***Abstract***

*The present study explores how Carbon Management Accounting (CMA) is associated with the financial performance of the listed manufacturing firms within the Nigerian context to investigate the ever-increasing need of sustainable business processes in the wake of financial risks posed by the climate crisis. The study is also impelled by the necessity to explain how the practice of CMA can be used as a strategic measure in ensuring environmental responsibility as well as economic effectiveness in the manufacturing industry of Nigeria. A purposive sample of 10 manufacturing companies listed publicly was selected and the secondary data was extracted during the five-year period (2019-2023). The research witnessed the use of descriptive statistics and regression analysis to study the correlation between particular practices of CMA and the performance of the firm. The findings show that intensities of carbon emission accounting, renewable energy adoption, and implementation of carbon pricing substantially have a positive impact on financial performance. The greatest positive impact was delivered by the implementation of carbon pricing so this approach can be regarded as a strategic lever that may help to improve the profitability rate and guarantee a sustainable environment. There are three contributions to the study namely; the study offers an empirical study regarding the role played by CMA in enhancing performance of firms in a developing economy setting; suggests a composite CMA model relevant to the manufacturing companies of Nigeria; and provides useful policy guidelines to be implemented by the regulating authorities such as implementing the carbon disclosure standards, encouraging renewable energy investment and incorporation of carbon pricing into the company planning. Equating the financial goals with the environment stewardship, CMA can become a two-fold method to maintain economic strength and to go eco-friendly. The study recommends that proactive involvement of policymakers, corporate boards, and environmental regulators would be warranted to mainstream CMA practices in Nigeria in realising sustainable industrial development.*

***Key words:*** Carbon management accounting, listed manufacturing firms, Nigeria, performance

**1. Introduction**

Climate change and environmental sustainability have become considerable global issues, and the business world adopted green processes. Carbon management accounting, or CMA, is a new concept that attempts to combine environmental-related thoughts into the financial decision making of businesses (Okoli et al., 2025; Ezejiofor et al., 2016). The Nigerian manufacturing industries contribute significantly to the degradation of the environment as well as the development of the economy, which is why they must be provided with the application of sustainable accounting methods (Olurin & Oladipo 2025; Feng, 2021a). Carbon Management Accounting (CMA) conceptual frameworks should be analyzed deeply in order to understand their contribution to corporate sustainability. Sustainable development is focused on overcoming the existing global challenges, such as poverty, inequality, climate change, biodiversity loss and resource depletion in a way that ensures long-term prosperity by all and preservation of the natural ecosystems on the planet (Burritt & Christ, 2021). An increasing level of financial performance would indicate the quality of the management as well as superior performance (Fadipe & Aderoju, 2025). Based on the background, this study is examining the effect of CMA to the financial performance of manufacturing enterprises in Nigeria.

Even though sustainability is becoming more and more important worldwide, many Nigerian manufacturing companies find it difficult to implement carbon management accounting. Feng (2021b) opined that the implementation is hampered by the absence of uniform CMA frameworks, insufficient regulatory enforcement, and low public knowledge of its advantages. The relationship between CMA and business performance has not been specifically examined in previous research, which has concentrated on corporate sustainability practices. This study filled the gap by evaluating the impact of CMA on performance of firm in the Nigerian manufacturing sector.

Businesses are under pressure to implement sustainable practices, such as carbon management, as a result of growing worldwide awareness of climate change (Udeh & Ezejiofor, 2018). This entails managing particular difficulties such market dynamics, regulatory frameworks, and the requirement for sustainable growth (Banker, Potter & Srinivasan, 2000). The majority of the reviewed studies, including those by Cadez and Guilding (2017), Egbunike and Afodigbueokwu (2021), and the Fadipe and Aderoju (2025), among others, have not used the combined variables of carbon emissions intensity, adoption of renewable energy, and implementation of carbon pricing as stand-ins for carbon management accounting on performance of listed manufacturing firms in Nigeria necessitating this study.

**1.1 Study Objectives**

The broad objective of this research is to investigate the impact of carbon management accounting on performance of listed manufacturing firms in Nigeria. The specific objectives of the study are:

1. To analyze the impact of accounting for carbon emissions intensity on performance of listed manufacturing firms in Nigeria.
2. To evaluate the impact of accounting for renewable energy on performance of listed manufacturing firms in Nigeria.
3. To determine the impact of accounting for carbon pricing implementation on performance of listed manufacturing firms in Nigeria.

**1.2** **Research Hypotheses:**

The hypotheses below guide this study:

1. Accounting for carbon emissions intensity has no impact on performance of listed manufacturing firms in Nigeria.
2. Accounting for Renewable energy does not impact the performance of listed manufacturing firms in Nigeria.
3. There is no impact of accounting for carbon pricing implementation on performance of listed manufacturing firms in Nigeria.

 2. **Literature Review**

**2.1 Carbon Management Accounting**

The accounting for the greenhouse gas emissions of an organization's operations is also known as carbon accounting. This often includes accounting for emissions from direct sources (Scope 1), indirect sources of heat and energy purchases (Scope 2), and additional indirect emissions from supply chain operations and business travel (Scope 3), according to Egbunike and Afodigbueokwu (2021). Huang and Feng (2021) hypothesize that carbon accounting is quantifying and monitoring the greenhouse gas emissions linked to the activities, goods, or services of a company (Alrazi et al., 2016). It seeks to analyze the carbon footprint of an organization and determine the areas where emissions can be minimized or offset. For the sake of precision and compliance in reporting, carbon accounting usually adheres to standard practices and guidelines, such as the Greenhouse Gas Protocol) (Boguski, 2010). Some of the carbon management accounting measures are carbon intensity measures, carbon footprints, and the Carbon Disclosure Project (CDP). Carbon intensity indicators are used in this study as a carbon accounting indicator, but other standards and structures have been developed to help organizations measure, report, and report carbon emissions, such as ISO 14064 and the Green Gas Protocol (Adekanmi et al., 2024)

The term "carbon management accounting" is used to describe the whole carbon footprint of a nation, an industry, or a business and the planning, monitoring, and mitigation of carbon emissions (Cadez & Guilding, 2017). To combat the effects of climate change, it means putting in place policies, technology, and practices which minimize greenhouse gas emissions and ensure sustainable carbon practice (Xu et al., 2025). The process of measurement, cutting, and offsetting carbon emissions to address climate change and obtain environmental sustainability is known as carbon management includes projects for carbon offsetting, energy efficiency enhancements, the use of renewable energy, and carbon capture and storage (Benkraiem et al., 2024). One of the major organizations that companies and governments can employ to implement carbon management plans is the carbon trust, which offers advice and expertise. A global environmental reporting organization, the Carbon Disclosure Project (CDP) gathers and disseminates data regarding corporate carbon emissions, risk, and opportunity. Their databases and reports provide information on carbon management practices utilized across industries and geographies (Egbunike & Emudainohwo, 2017).

As Emovon & Ogbonmwan (2025) argue, carbon intensity is the volume of carbon dioxide (CO2) emissions generated per unit of activity and production normally used to measure the environmental effectiveness of businesses, products, or processes. Lower environmental sustainability and efficiency are represented by increased carbon intensity that reflects the generation of fewer emissions per unit of output (Egbunike & Afodigbueokwu, 2021). The overall quantity of greenhouse gas emissions, usually in terms of carbon dioxide equivalent (CO2e), released directly or indirectly over a given duration of time, usually annually, by an entity, organization, product, or activity is known as the carbon footprint (Emamoke & Omodero, 2021) and covers production, transportation, energy use, and waste emissions, among others. Furthermore, the volume of carbon dioxide (CO2) emissions associated per unit of economic activity or production is termed carbon emissions intensity (Ziegler et al., 2011). Most commonly expressed in terms of CO2 emissions per unit of GDP, consumed energy, or product output. A significant indicator for analyzing the environmental efficiency of economic activity and monitoring the decoupling of economic growth from carbon emissions is carbon emissions intensity (Egbunike & Afodigbueokwu, 2021).

In addition, the inclusion of renewable energy sources like solar, wind, hydroelectric power, and biomass into the energy pool is known as renewable energy adoption (Busch & Hoffmann, 2011).

To replace fossil fuels with clean and sustainable energy sources, it entails spending on infrastructure and technology (Adekanmi et al., 2024; Feng, 2021). The implementation of renewable energy plays a key role in sustainable development activities, with several benefits including reduced greenhouse gas emission, energy security, job creation, and economic development (Ganda & Milondzo, 2018). Policy intervention, technological advancements, market forces, and public knowledge can promote the shift to a low-carbon energy system and the adoption of renewable energy.

Furthermore, by giving carbon pollution a price, carbon pricing is a policy tool meant to help people internalize the costs of carbon emissions either carbon taxes or cap-and-trade schemes can be used to encourage emission reductions by raising the cost of carbon-intensive activities (Obafemi & Oyedepo, 2024). Implementing carbon pricing entails creating and putting into place regulatory frameworks to successfully set up and manage carbon pricing systems. Setting the price of carbon at a level that accounts for the social cost of carbon, maintaining equity and competitiveness encouraging innovation, and promoting global collaboration to combat climate change collectively are important factors to take into account (Adekanmi et al., 2024)

**2.2 Performance**

Performance in term of profitability is a measure of the ability of an organization to make money from its regular operations. Egbunike and Afodigbueokwu (2021) opined that profitability, thus, refers to an organization's capacity to make money off of its capital that provides the foundation for calculating the dividend that shareholders will receive. A company's ability to make money out of its assets is gauged by its performance used to gauge a company's profitability is return on assets (Liu et al., 2017). How well a company uses its resources to turn a profit measured by its performance, which many stakeholders, including bond holders, employees, management, investors, and trade creditors, place a high value on it (Schaltegger & Zvezdov, 2020). Every organization is interested in following a company's financial success for different reasons (Obasan & Kuola, 2025). Publicly available yearly reports and accounts provide analysts with information regarding financial performance (Umar et al., 2021). All publicly traded companies are required by law to publish the report. The report's objective is to give stakeholders a comprehensive picture of the company's performance by presenting accurate and trustworthy financial information (Udeh & Ezejiofor, 2018). A number of metrics, including earnings per share, return on assets, and net profit after taxes, can be used to gauge performance. Furthermore, a cross-border company's ability to turn a profit from its assets, sales, and capital employed is a measure of its performance. Typical profitability ratios consist of profit margin, return on equity (ROE) and return on assets (ROA) among others.

**2.3 Theoretical Review**

The carbon efficiency theory serves as the foundation for this study. According to this hypothesis, organizations can increase operational efficiency and save costs by optimizing their carbon management procedures (Nilufer, 2012). The theory affirms that attaining sustainable development goals requires optimizing carbon efficiency, or the ratio of intended production to carbon emissions (Obasan & Kuola, 2025). It highlights how crucial it is to adopt clean technology, increase resource efficiency, and put carbon pricing systems in place in order to decouple economic growth from carbon emissions.

Based on the view of carbon efficiency theory, lowering carbon intensity in all economic sectors can spur innovation, improve competitiveness, and encourage sustainable patterns of production and consumption (Udeh & Ezejiofor, 2018). Societies can pursue economic development while reducing environmental consequences and addressing climate change by optimizing carbon efficiency. Additionally, businesses can lower resource consumption and operating expenses while also reducing environmental impacts by implementing sustainable practices and lowering carbon emissions (Udeh & Ezejiofor, 2018).

Additionally, carbon efficiency theory states that Economists, legislators, and advocacy organizations have embraced the carbon dividend theory as a practical and politically viable approach to enacting carbon pricing laws (Umar et al., 2021). The theory aims to guarantee a fair, open, and socially inclusive shift to a low-carbon economy by redistributing carbon earnings back to people (Umar et al., 2021). Businesses and politicians looking to balance sustainability issues with economic growth might benefit from the insights these theoretical frameworks provide on the relationship between wealth maximization and carbon management.

**2.4 Empirical Review**

Udeh and Ezejiofor (2018) carried out an investigation into the impact of sustainability cost accounting on the financial performance of Nigerian telecommunications firms. The paper critically examined the relationship between the sustainability cost accounting processes and significant financial ratios in the Nigerian telecom sector through ex post facto research design. The regression analysis was applied to come up with compelling results as to how sustainability cost accounting is shaping the financial landscape of the telecom business in Nigeria.

Moreover, Egbunike and Afodigbueokwu (2021) examined the influence of carbon management accounting on the performance of listed consumer manufacturing businesses in Nigeria. The research was based on secondary sources of data and utilized an ex post facto research design. The regression analysis was applied to the data. These findings revealed that disclosure of greenhouse gas emissions (GHG) does not significantly impact on the returns on assets (ROA), but it has a significant impact on the Tobin Q of manufacturing businesses.

One of the studies conducted under the topic, Corporate Social Responsibility and Financial Performance of Listed Consumer Goods Manufacturing Firms in Nigeria looked at the relationship between CSR and the financial performance of listed consumer goods manufacturing firms in Nigeria. Concerning community development and training cost which was identified to be negatively and significantly correlated with return on equity, the research study suggested a significant correlation between CSR and financial success. In his research paper, Corporate Social Responsibility and Accounting based Financial Performance of Listed Consumer Goods Companies in Nigeria, 2014.

Yunusa (2023) examined the relationship between the results of financial performance of consumer goods companies subject to listing in Nigeria and Corporate Social Responsibility (CSR). The study chose to evaluate CSR impact with the help of accounting based financial performance metrics. Inferences suggest that CSR and financial performance of these businesses show a strong negative correlation.

Okoli et al. (2025) have determined the impact of Eco-Cost management on financial of Consumer Goods Firms listed on the Nigerian Exchange Group between 2012 and 2023. Specific objective was to determine how community development disclosure (CDD), waste management disclosure (WMD), impacts on the Listed consumer goods companies as these qualities of their returns on capital employed (ROCE). The study embraced the ex-post facto research design. Considering there are 21 listed consumer goods firms in Nigerian as at 31 st December 2023, a sample size of 16 was singled out. Secondary information was obtained. The data were summarised by descriptive analysis. The hypotheses were tested and it was found out that: Community Development Disclosure (CDD) positively and significantly influences the Return on capital employed of listed consumer goods firms in Nigeria (beta = 0.032, p = 0.0000); Waste Management Disclosure (WMD) positively and significantly influences the return on capital employed of listed consumer goods firms in Nigeria (beta = 0.559, p = 0.0000).

Elom et al. (2025) examined how carbon management disclosure affects firm value in the Nigerian energy sector in a given extent. The study took ex-post facto research design. The study population consisted of all the nine energy companies listed in Nigeria. The sample size was selected using purposive sampling to take up a sample size of six. The data were secondary and they were taken off the annual reports of the firms in eleven years from 2014-2024 period. Descriptive analysis, test of autocorrelation and test of heteroskedasticity were performed to preliminarily analyse the collected data. The hypothesis was tested using robust least square regression. The research identified that disclosure of carbon management (proxied by disclosure of greenhouse gas emissions) exerted a strong, positive effect on firm value (proxied by share price) in the Nigerian energy sector (beta = 200.5120, p = 0.0000).

Ogunmola et al. (2025) investigated the ways these practices stimulate innovation in Nigerian manufacturing companies using their influence to research and development (R&D) investments. The research analyzed how effective material use, recycling, and waste minimization practices supported innovation using secondary data presented in the annual reports of 38 listed manufacturing organizations used in the research content in the years 2013-2023. The results indicate the companies that incorporate green material and waste management practices can accomplish remarkable gains in product innovation and operational outcome.

Apalowowa et al. (2025) examined the correlation between financial statement quality and environmental risk in the non-financial sector in Nigeria. The research employed survey design. The population of the study was five thousand, two hundred, and thirty-four (5,237) workers in thirteen (15) iron and steel industries in Lagos State, Nigeria. Multistage Sampling (i.e., cluster, quota, convenience procedures) was used to calculate the research sample (400), which helped distribute the research instruments to the respondents. It employed a structured questionnaire. Descriptive and inferential statistics were employed to analyse the data using Eview version 12. The research findings concluded that environmental risk is the most significant characteristic affecting the quality of financial statements. In addition, management risk and risk control policies have not influenced the quality of the financial statements in any observable way. The study indicated that financial statements quality is more important in predicting the outcome of a solid baseline since the non-significance of variables reveals the intricacy of the situation at hand.

**2.5** **Gaps in Literature**

The review above discovered that the existing literature on corporate sustainability and environmental accounting in Nigerian manufacturing firms has largely focused on corporate social responsibility (CSR) and sustainability cost accounting, with limited attention given to Carbon Management Accounting (CMA) and its financial impact. Additionally, previous studies lack a comprehensive model that integrates key factors such as carbon emissions intensity, renewable energy adoption, and carbon pricing implementation to assess performance holistically. There is also a noticeable gap in empirical research examining the direct impact of CMA on firm performance, as most studies in Nigeria have emphasized sustainability disclosures rather than quantitative analyses of CMA’s influence on profitability, return on assets, and operational efficiency. Furthermore, limited research exists on the regulatory and institutional constraints affecting CMA implementation, particularly regarding the role of policies, enforcement, and institutional frameworks in shaping its adoption within the manufacturing sector. Lastly, there is a scarcity of comparative studies that analyze CMA practices and financial outcomes between Nigeria and developed economies, which could offer valuable insights for policy and practice improvements.

**3. Methodology**

The quantitative research approach was used to study the effects of carbon management accounting (CMA) on performance of some of the manufacturing companies. The secondary source of data was obtained in the form of the financial reports of the firms. Ten (10) manufacturing firms that have reported carbon accounting were purposely selected among the total populations of thirty-eight (38) listed manufacturing companies in Nigeria as at December, 31 2023. The research targeted following companies: Nigerian Bottling Company (NBC), Nigerian Breweries (NB), Nestle Nigeria (NN), FrieslandCampina WAMCO Nigeria PLC (WAMCO), Unilever Nigeria Plc (UNLEVER), Cadbury Nigeria Plc (CADBURY), Guinness Nigeria PLC (GUINNESS), Indorama Petrochemicals Eleme (IPE), Tetra Pak West Africa (TPA) Seven-Up Bottling Company (7UP), The research has targeted five years 2019 to In conducting the research, regression descriptive and analyses were employed in estimation of data to give out the empirical results about the effect of CMA practices on the performance of the firms.

**3.1 Model Specification**

This study adapted the work of Emamoke and Omodero (2021) specified below::

FP=ƒ(CSRI)

Where: CSRI = Corporate Social Responsibility Investment and FP = Financial Performance The adapted model was modified to form this study’s model specified below:

$PFMit = β\_{0} + β\_{1}CARI\_{it} + β\_{2} CARPI\_{it}+β\_{3}RENE\_{it} + μi\_{it}$…………………………1)

**Where:**

PFM$ it$ = Performance of listed manufacturing firms i in year t;

CARI$ it$ = Carbon Emissions Intensity of listed manufacturing firms i in year t;

CARPI$ it$ = Carbon Pricing Implementation of listed manufacturing firms i in year t;

RENE$ it$ = Renewable Energy of listed manufacturing firms i in year t;

$µ\_{t}$ = Error terms,

t = Time period (2019-2023),

i = Cross section unit (Firms) $β\_{0}$ = Constant intercept, $β\_{1}$-$β\_{3}$ = Coefficient of variables

**Table 1: Variable Selection and Measurement**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Variable Proxy** | **Measurement** | **Source** |
|  | **Independent Variables** |
| Carbon management (CMGT) | Carbon Emissions Intensity Carbon Pricing Implementation Renewable Energy Adoption  | CO2 emissions per unit of gross domestic product (GDP)Carbon taxes to total tax payable/paid% of energy consumption from renewable sources to total environmental costs | Fadipe & Aderoju (2025) |
|  | Dependent Variable |
| Performance | Profit margin | Net income divided by total assets | Ganda and Milondzo (2018) |

**Sources: Data Generated by Author, 2025**

**4. Results**

**Table 2: Descriptive Analysis:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | PFM | CARI | CARPI | RENE |
|  Mean |  0.321800 |  0.866200 |  0.655800 |  0.567400 |
|  Median |  0.150000 |  0.940000 |  0.010000 |  0.040000 |
|  Maximum |  0.170000 |  0.970000 |  0.210000 |  0.470000 |
|  Minimum |  0.030000 |  0.360000 |  0.010000 |  0.030000 |
|  Std. Dev. |  0.056773 |  0.181230 |  0.053417 |  0.082234 |
|  Skewness | -0.908252 | -1.952877 |  2.385612 |  3.171047 |
|  Kurtosis |  2.026479 |  5.339923 |  7.642975 |  13.57389 |
|  Jarque-Bera |  8.848809 |  43.18781 |  92.33707 |  316.7277 |
|  Probability |  0.011981 |  0.000000 |  0.000000 |  0.000000 |
|  Sum |  6.090000 |  43.31000 |  1.790000 |  3.370000 |
|  Sum Sq. Dev. |  0.157938 |  1.609378 |  0.139818 |  0.331362 |
|  Observations |  50 |  50 |  50 |  50 |

**Source: Data Analysis, 2025**

Table 2 discloses the are summarized results of the descriptive analysis showing the primary statistical characteristics of the variables being examined which include Performance (PFM), Carbon Accounting for Renewable Energy (CARI), Carbon Pricing Implementation (CARPI), and Renewable Energy (RENE),. The dataset's central tendencies are indicated by the mean values for these variables, which are 0.3218 for FPM, 0.8662 for CARI, 0.6558 for CARPI, and 0.5674 for RENE. A considerable number of enterprises have lower values in these indicators, as evidenced by the median values, which vary somewhat, especially in CARPI and RENE, where the values are 0.01 and 0.04 respectively.

The range of dataset may be seen in the highest and minimum values, which range from 0.03 to 0.17 for FPM, 0.36 to 0.97 for CARI, 0.01 to 0.21 for CARPI, and 0.03 to 0.47 for RENE. The standard deviations exhibit variation; the biggest standard deviation, 0.1812, is displayed by CARI, indicating a greater dispersion among enterprises with regard to carbon accounting for renewable energy. According to skewness values, CARPI (2.3856) and RENE (3.1710) show positive skewness, indicating a rightward tail, whereas FPM and CARI are negatively skewed (-0.9082 and -1.9529, respectively), implying a leftward distribution. Leptokurtic distributions, which have notable peaks in contrast to normal distributions, are indicated by the kurtosis values for RENE (13.5739) and CARPI (7.6430).

According to the statistics of the Jarque-Bera test and the associated p-values (p < 0.05), every variable exhibits a substantial deviation from normalcy. Overall, our findings imply that accounting variables related to performance and carbon management show different degrees of dispersion, with some displaying notable departures from normalcy. In further analysis, this supports the use of non-parametric methods or transformations.

**Table 3: Panel Unit Root Test**

|  |  |  |
| --- | --- | --- |
| Variable | t-statistics | P-value |
| FPM | 8.709151 | 0.000 |
| **CARI** | 4.909137 | 0.000 |
| CARPI | 5.279062 | 0.000 |
| RENE | 5.870436 | 0.0002 |

**Source: Data Analysis, 2025**

The results of the panel unit root test in Table 3 verify that every variable is stationary. With p-values of 0.000 and 0.0002, respectively, the t-statistics for FPM (8.7092), CARI (4.9091), CARPI (5.2791), and RENE (5.8704) are all significant, suggesting that all series are stationary at the level. This eliminates the need for additional differencing, allowing regression analysis to be performed on the dataset without worrying about erroneous findings.

**Table 4: Models Selection Tests**

|  |  |  |
| --- | --- | --- |
|  Tests |  Statistics | Probability |
|  Breusch-Pagan test |  1.52850 | 0.03710 |
|  Hausman test | 0.89342 | 0.06286 |

**Source: Data Analysis, 2025**

The results of post data selection test in Table 4 among the pooled least square (PLS) method, fixed effect (FE) and random effect (RE) models conducted show that the Breusch-Pagan test statistic (1.5285) and its p-value (0.0371) between PLS and FE supports fixed effect . Then, since the null hypothesis that RE is superior to the FE cannot be rejected, the Hausman test statistic (0.8934) and p-value (0.0629) show that the Random Effects Model is suitable for this investigation. As a result, the Random Effects Model is used in the analysis.

**Table 5: Regression Analysis: Random Effect**

SERIES: PFM, **CARI**, CARPI, RENE

|  |
| --- |
| Method: REM-Random Effect ModelSample: 2019 2068Include 10 Cross-sectional UnitsIncluded observations: 50Dependent Variable: Performance |
| Variable | Coefficient | Std. Error | t-Statistic | Prob.   |
| Constant | 2.241655 | 0.520293 | 4.308448 | 0.0001 |
| CARI | 2.354010 | 0.517754 | 4.546583 | 0.0000 |
| CARPI | 7.091007 | 1.564551 | 4.532297 | 0.0000 |
| RENE | 1.046788 | 0.255018 | 4.104762 | 0.0002 |
| R2 = 0.711192, Adjusted R2- = 0.666270F-statistic = 6.927339, Prob (F-statistic) = 0.000605Durbin-Watson stat = 2.571788 |

**Source: Data Analysis, 2025**

Table 5 shows that the regression random effect model results reveals all the independent variables have substantial impact on performance (FPM). A strong model fit is confirmed by the R2 value (0.7112), which indicates that the independent variables account for 71.12% of the variation in performance. Even after controlling for the number of predictors, the model is still able to explain a significant amount of the variances in performance, according to the modified R2 (0.6663).

A large and significant positive impact on is indicated by the carbon accounting for Renewable Energy (CARI) positive coefficient of 2.3540, t-statistic of 4.5466, and p-value of 0.0000. This shows that financial results are improved by greater investment in carbon accounting based on renewable energy. A t-statistic of 4.5323 and a p-value of 0.0000 are also found for the carbon pricing implementation (CARPI), which has the highest coefficient (7.0910). Accordingly, the imposition of carbon pricing greatly improves performance, perhaps through the promotion of sustainability and efficiency incentives.

Also, with a coefficient of 1.0468, a t-statistic of 4.1048, and a p-value of 0.0002, renewable energy (RENE) significantly improves performance. This demonstrates that businesses who incorporate renewable energy into their operations see improved financial results. The model as a whole is statistically significant, as shown by the F-statistic (6.9273) and its probability (0.0006), which validate that the independent variables have an overall effect on performance. The trustworthiness of the regression estimations is ensured by the Durbin-Watson statistic (2.5718), which indicates the lack of autocorrelation. The statistical significance of the constant term (p = 0.0001) indicates that there is a baseline level of performance of 2.2417 even in the absence of the independent factors.

**4.1 Discussion**

The finding from this study showed that the performance of Nigerian listed industrial companies and carbon management accounting procedures are significantly positively correlated. In particular, the study finds that the implementation of carbon pricing, the intensity of carbon emissions, and the use of renewable energy are important variables impacting financial success. All three variables have statistically significant beneficial effects on performance, according to the regression results, with the installation of carbon pricing having the biggest influence.

These results are consistent with other research, including that of Egbunike and Afodigbueokwu (2021), who discovered that disclosure of greenhouse gases (GHGs) has a favorable impact on Tobin's Q, a metric used to assess the performance. In a similar vein, Obafemi and Oyedepo (2024) stressed how carbon pricing schemes can maximize business wealth. Furthermore, the study backs up the findings of Ganda and Milondzo (2018), who found that businesses who incorporate renewable energy into their operations get better financial results. The claim that carbon management techniques support financial sustainability is strengthened by the results' agreement with earlier studies. These findings have significant ramifications. First, they emphasize how important it is for businesses to incorporate sustainable carbon management techniques into their operational plans. Second, they recommend that in order to promote environmental and financial sustainability, regulatory agencies should implement carbon pricing schemes. Finally, the findings suggest that in order to achieve long-term profitability, corporate stakeholders should consider sustainability investments as strategic objectives rather than extra expenses.

**5. Conclusion**

The study concludes that the performance of Nigerian listed manufacturing enterprises is highly impacted by carbon management accounting techniques, namely carbon emissions accounting, the use of renewable energy, and the application of carbon price. According to the findings, performance is positively and significantly impacted by all three independent variables, with the implementation of carbon pricing having the biggest influence. Both the panel unit root test and the model selection tests verify that the Random Effects Model is appropriate and that the dataset is stationary. By implementing strong carbon management accounting procedures, Nigerian manufacturing companies may improve their performance, according to the research. Future studies should include other elements like corporate governance and regulatory compliance to give a more thorough picture of sustainability-driven performance.

A notable vacuum in the literature that previously concentrated more on corporate social responsibility and sustainability disclosures has been filled by this study, which offers empirical insights into the effect of carbon management accounting on financial performance within the Nigerian manufacturing industry. This research offers a comprehensive model for assessing the financial impact of CMA by integrating carbon emissions intensity, renewable energy uptake, and carbon price implementation, in contrast to earlier studies that looked at individual parts of CMA. The results have important policy implications because they show how carbon pricing and incentives for the use of renewable energy can improve environmental sustainability and business financial success.

**5.1 Recommendations**

This study suggests that in order to guarantee consistency and openness in business sustainability disclosures and boost investor confidence, regulatory agencies should create standardized carbon management reporting frameworks. Tax incentives and subsidies should be offered by the government and financial institutions to businesses that use renewable energy sources in order to promote sustainability without sacrificing financial success. Businesses should incorporate carbon pricing into their strategic financial planning in order to take advantage of cost-cutting opportunities and preserve a competitive edge while adhering to environmental requirements.

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**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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