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GREENHOUSE GAS EMISSION DISCLOSURES AND FINANCIAL PERFORMANCE OF LISTED PHARMACEUTICAL FIRMS IN NIGERIA

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Abstract

This study examined the relationship between greenhouse gas emission disclosures and financial performance of listed pharmaceutical firms in Nigeria. However, the specific objectives were to evaluate the relationship between emission intensity disclosure and financial performance of listed pharmaceutical firms in Nigeria, to examine the relationship between energy efficiency disclosure and financial performance of listed pharmaceutical firms in Nigeria, to determine the relationship between renewable energy consumption disclosure and financial performance of listed pharmaceutical firms in Nigeria, to analyze the relationship between carbon footprint disclosure and financial performance of listed pharmaceutical firms in Nigeria and to investigate the relationship between emission trends disclosure and financial performance of listed pharmaceutical firms in Nigeria. The study adopted an *ex-post facto* research design and utilized a panel data of seventy (70) pooled observations gathered from seven (7) listed pharmaceutical firms in Nigeria over ten (10)-year period (2015-2024). The study however employed a panel multiple regression technique to analyze the data via E-views 10.0 statistical package. The study findings revealed that emission intensity disclosure has a significant negative relationship (Coeff. = -0.000619, p-value = 0.0088) with financial performance of listed pharmaceutical firms in Nigeria, energy efficiency disclosure has no significant relationship (p-value = 0.3780) with financial performance of listed pharmaceutical firms in Nigeria, renewable energy consumption

disclosure has a significant negative relationship (Coeff. = -0.069355, p-value = 0.0460) with financial performance of listed pharmaceutical firms in Nigeria while carbon footprint disclosure has no significant relationship (p-value = 0.1095) with financial performance of listed pharmaceutical firms in Nigeria. It also revealed that emissions trend disclosure has a significant positive relationship (Coeff. = 0.085349, p-value = 0.0099) with financial performance of listed pharmaceutical firms in Nigeria. It was thus concluded that greenhouse gas emission disclosures have a significant relationship with financial performance of pharmaceutical firms listed on the Nigerian Exchange Group (NGX). The recommendations made included that pharmaceutical firms in Nigeria should prioritize reducing their emission intensity, as high emission intensity is negatively associated with financial performance. This can be achieved by implementing energy-efficient practices, investing in cleaner production technologies, and adopting sustainable supply chain practices.

Keywords:

GREENHOUSE GAS, GAS EMISSION, FINANCIAL PERFORMANCE.

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1.0 INTRODUCTION

Greenhouse gas emission disclosures are the reporting of the amount and type of greenhouse gases that an organization emits as a result of its operations. These disclosures are becoming increasingly important as part of corporate sustainability and environmental reporting efforts. The pharmaceutical industry is a significant contributor to greenhouse gas (GHG) emissions, primarily due to its energy-intensive manufacturing processes (Emmanuel et al., 2023). As concern about climate change continues to grow, there is increasing pressure on companies, including those in the pharmaceutical sector, to disclose their GHG emissions and implement strategies to reduce them as postulated by Chen, (2023). In Nigeria, pharmaceutical firms are not exempt from this trend, and there is a growing need for them to prioritize sustainability and transparency in their operations (Okpo et al., 2024). GHG emission disclosures are becoming increasingly important for companies, as stakeholders; including investors, customers, and regulators, demand more information about their environmental impact (Prince et al., 2023; Okpo et al., 2024; Akpan & Nkanta, 2023).

Greenhouse gas emission disclosures can provide valuable insights into a company's sustainability performance and its ability to manage environmental risks (Akpan & Simeon, 2021; Emenyi et al., 2024; Samuel et al., 2024; Okpo & Emenyi, 2023). In Nigeria, the Nigerian Exchange Group (NGX) has introduced sustainability disclosure guidelines, which require listed companies, including pharmaceutical firms, to disclose their environmental, social, and governance (ESG) performance as stated by Akpan and Nkanta (2023) alongside Prince et al. (2023). Despite the growing importance of GHG emission disclosures, there is limited research on the relationship between these disclosures and financial performance in the Nigerian pharmaceutical sector. Previous studies such as Okpo (2020) have examined the relationship between sustainability disclosures and financial performance in other industries

and countries, but there is a need for more country-specific and industry-specific research. This study aims to address this gap by investigating the relationship between GHG emission disclosures and financial performance of listed pharmaceutical firms in Nigeria.

The variables of greenhouse gas emission disclosure that will be examined in this study are emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure. Emission intensity disclosure refers to the disclosure of a company's GHG emissions per unit of production or sales (Hewagama et al. 2025). Energy efficiency disclosure refers to the disclosure of a company's efforts to reduce energy consumption and improve energy efficiency (Akpan, 2024). Renewable energy consumption disclosure refers to the disclosure of a company's use of renewable energy sources, such as solar or wind power (Salehi et al., 2022). The financial performance of listed pharmaceutical firms in Nigeria will be measured using financial metrics such as gross profit margin. These metrics will provide insights into the financial health and profitability of the companies, and will be used to examine the relationship between GHG emission disclosures and financial performance (Sarro &Prayettoni, 2020; Aharon et al., 2024; Emenyi & Okpokpo, 2023).

Therefore, this study aims to contribute to the existing literature on sustainability disclosures and financial performance, and to provide insights into the relationship between GHG emission disclosures and financial performance in the Nigerian pharmaceutical sector. The findings of this study will be useful for stakeholders, including investors, regulators, and managers of pharmaceutical firms, who are interested in understanding the relationship between sustainability disclosures and financial performance.

Unfortunately, the lack of comprehensive understanding regarding the disclosure practices of greenhouse gas emissions among pharmaceutical companies in Nigeria highlights a critical gap in knowledge within the industry. The increasing awareness of climate change and its devastating impacts on the environment has led to growing pressure on companies to prioritize sustainability and transparency in their operations (Akpan & Simeon, 2021; Emenyi et al., 2024; Han et al., 2023). In Nigeria, listed pharmaceutical firms were not exempted from this trend, and there was a need for them to disclose their greenhouse gas emissions and implement strategies to reduce them as seen in Pietro et al., (2023). However, the relationship between GHG emission disclosures and financial performance of these firms was not well understood, and this knowledge gap poses a significant problem for stakeholders, including investors, regulators, and managers of pharmaceutical firms as opined by (Akpan & Nkanta, 2023) alongside (Prince et al., 2023).

The study aimed at addressing this knowledge gap by investigating the relationship between GHG emission disclosures and gross profit margin of listed pharmaceutical firms in Nigeria. The study provided insights into the financial implications of GHG emission disclosures on pharmaceutical firms and will inform stakeholders, including investors, regulators, and managers of pharmaceutical firms, about the importance of prioritizing sustainability and transparency in their operations (Emenyi, 2024). The main objective of this study was to ascertain the relationship between greenhouse gas emission disclosures and financial performance of listed pharmaceutical firms in Nigeria. However, the specific objectives were to:

1. Evaluate the relationship between emission intensity disclosure and financial performance of listed pharmaceutical firms in Nigeria.

2. Examine the relationship between energy efficiency disclosure and financial performance of listed pharmaceutical firms in Nigeria.
3. Determine the relationship between renewable energy consumption disclosure and financial performance of listed pharmaceutical firms in Nigeria.
4. Analyze the relationship between carbon footprint disclosure and financial performance of listed pharmaceutical firms in Nigeria.
5. Investigate the relationship between emission trends disclosure and financial performance of listed pharmaceutical firms in Nigeria.

2.0 LITERATURE REVIEW

2.1 Conceptual framework

GREENHOUSE GAS EMISSION DISCLOSURES

The concept of greenhouse gas emission disclosure refers to the practice of companies providing information about their greenhouse gas emissions, which contribute to climate change. This disclosure can include quantitative data on the amount of emissions, as well as qualitative information on the company's strategies and policies for managing and reducing emissions (Okpo, 2020; Samuel et al., 2024). Greenhouse gas emission disclosure is an important aspect of environmental reporting, which is increasingly being recognized as a key component of corporate social responsibility and sustainability reporting (Okike et al., 2024).

According to Prince et al. (2023), the concept of greenhouse gas emission disclosure is rooted in the idea that companies have a responsibility to be transparent about their environmental impacts, and that stakeholders, including investors, customers, and regulators, have a right to access this information. By disclosing their greenhouse gas emissions, companies can demonstrate their commitment to environmental sustainability, manage their reputation and brand, and mitigate potential risks associated with climate change (Ajayi & Anjorin, 2020; Akpan & Simeon, 2021). Furthermore, greenhouse gas emission disclosure can also help companies to identify areas for improvement, set reduction targets, and develop strategies to reduce their environmental footprint as postulated by (Akpan & Nkanta, 2023) alongside (Prince et al., 2023).

The disclosure of greenhouse gas emissions can take various forms, including standalone sustainability reports, integrated reports, and online platforms (Emeh & Eze, 2022; Okpo & Emenyi, 2023). Companies may also participate in voluntary reporting initiatives, such as the Carbon Disclosure Project (CDP), which provides a framework for companies to disclose their greenhouse gas emissions and climate change strategies (Okpo, 2020). The quality and completeness of greenhouse gas emission disclosure can vary widely across companies, and researchers and stakeholders are increasingly developing metrics and frameworks to assess the quality of disclosure as recorded by Emmanuel et al. (2023). Overall, greenhouse gas emission disclosure is an important aspect of corporate sustainability reporting, and its significance is likely to continue to grow as companies, stakeholders, and regulators increasingly focus on environmental sustainability and climate change mitigation (Akande & Ali, 2021; Samuel et al., 2024; Okpo & Emenyi, 2023).

Component of greenhouse gas emissions disclosure

The greenhouse gases are carbon dioxide (CO2), methane (CH4), Nitrous oxide (N20), Fluorinated gases, Ozone (O3), water vapour (H20). Industrial gases; hydrofluorocarbons

(HFCs), Perfluorocarbons (PFCs), Sulfur hexafluoride (SF6), Nitrogen trifluoride (NF3). The main gas of greenhouse gases is carbon dioxide (CO2).

Emission intensity disclosure

Emission intensity disclosure is the practice of companies providing information about their greenhouse gas emissions in relation to a specific metric, such as production volume, revenue, or energy consumption. This disclosure allows stakeholders to assess a company's environmental performance and efficiency, and to compare it with industry peers or benchmarks (Yu et al., 2022; Akpan & Simeon, 2021). Rokhmawati et al., (2015) opined that emission intensity disclosure is an important aspect of environmental reporting, as it provides a more nuanced understanding of a company's environmental impacts than absolute emissions numbers alone. By disclosing emission intensity, companies can demonstrate their commitment to environmental sustainability, manage their reputation and brand, and identify areas for improvement (Makan & Kabra, 2021).

The concept of emission intensity disclosure is rooted in the idea that companies should be held accountable for their environmental performance, and that stakeholders have a right to access this information (Mardini & Elleuch, 2022). Emission intensity disclosure can take various forms, including metrics such as tons of CO2e per unit of production, per dollar of revenue, or per unit of energy consumed (Bedi & Singh, 2024). Companies may also disclose emission intensity trends over time, allowing stakeholders to assess progress towards environmental goals (Issa, 2024). The quality and completeness of emission intensity disclosure can vary widely across companies, and researchers and stakeholders are increasingly developing metrics and frameworks to assess the quality of disclosure as responded by Solomon et al., (2024).

Emission intensity disclosure has several benefits for companies, stakeholders, and the environment. For companies, it can help identify areas for improvement, optimize production processes, and reduce environmental risks. For stakeholders, it provides a more complete picture of a company's environmental performance, allowing for more informed investment decisions, purchasing choices, and regulatory oversight. For the environment, emission intensity disclosure can drive reductions in greenhouse gas emissions, as companies strive to improve their environmental efficiency and competitiveness (Solomon, 2024). Overall, emission intensity disclosure is an important aspect of corporate sustainability reporting, and its significance is likely to continue to grow as companies, stakeholders, and regulators increasingly focus on environmental sustainability and climate change mitigation (Han et al., 2023; Emenyi et al., 2024).

Energy efficiency disclosure

Moses and Clinton, (2023) postulated that energy efficiency disclosure is a critical component within the broader framework of sustainability reporting for listed pharmaceutical firms in Nigeria. This aspect focuses on the transparency and communication of information regarding the energy efficiency practices and measures implemented by pharmaceutical companies to optimize their energy consumption and reduce their environmental impact. Energy efficiency disclosure encompasses a wide range of initiatives, including technological upgrades, operational improvements, employee training, and behavioural changes aimed at minimizing energy waste and enhancing overall energy performance (Noh & Park, 2023). Emenyi and Okpokpo, (2023) supported that disclosing detailed data on their energy efficiency efforts, pharmaceutical firms can demonstrate their commitment to resource

conservation, emission reduction, and operational excellence in line with global sustainability objectives.

Effective energy efficiency disclosure can serve as a strategic tool for listed pharmaceutical companies in Nigeria to enhance their operational performance, reduce costs, and drive long-term profitability (Otti &Schiemam, 2023; Samuel et al., 2024). By proactively sharing information on their energy-saving initiatives, such as energy audits, equipment upgrades, lighting retrofits, and energy management systems, pharmaceutical firms can showcase their dedication to optimizing resource use and minimizing carbon emissions (Solomon, 2024).Han et al., (2023) stated that improved energy efficiency not only contributes to environmental stewardship but also enables companies to lower their utility expenses, increase their competitiveness, and mitigate risks associated with volatile energy prices and regulatory changes. Through transparent energy efficiency disclosure, pharmaceutical companies can demonstrate their ability to create long-term value for stakeholders while fostering a culture of sustainability and innovation within their organizations as reported by (Okpo et al., 2024; Prince et al., 2023; Okpo, 2020; Akpan, 2024).

Dharma et al. (2024) responded that energy efficiency disclosure can play a pivotal role in shaping investor perceptions, attracting socially responsible capital, and enhancing the overall reputation and market positioning of pharmaceutical firms in Nigeria. Investors increasingly consider environmental performance metrics, including energy efficiency indicators, as key factors in evaluating the sustainability and resilience of companies in their investment portfolios (Bagci et al., 2025). By openly communicating their energy efficiency strategies, progress, and outcomes, pharmaceutical firms can build trust with investors, differentiate themselves as leaders in responsible business practices, and access a broader pool of capital that values environmental, social, and governance (ESG) considerations. Ultimately, Agbo et al. (2024) summarized that integrating energy efficiency disclosure into their reporting frameworks can not only drive positive financial outcomes for pharmaceutical companies but also foster stakeholder trust, loyalty, and support for their sustainable growth objectives.

Renewable energy consumption disclosure

Renewable energy consumption disclosure in the context of greenhouse gas emission reporting for listed pharmaceutical firms in Nigeria is a crucial aspect that reflects the organizations' commitment to sustainability and environmental responsibility (Alkebsee, 2024). By disclosing information on their consumption of renewable energy sources, pharmaceutical companies can provide stakeholders with a clear understanding of their efforts to reduce carbon emissions and transition towards cleaner energy alternatives. This disclosure typically includes detailed data on the percentage of renewable energy sources utilized in the company's overall energy mix, such as solar, wind, hydroelectric, or biomass energy (Grahn, 2024; Akpan & Simeon, 2021). Pharmaceutical firms that prioritize renewable energy consumption disclosure demonstrate a proactive approach to mitigating their environmental impact and aligning their operations with global sustainability goals as supported by Agbo and Egbunike, (2024).

Moreover, transparency in renewable energy consumption disclosure can enhance the credibility and trustworthiness of pharmaceutical firms among investors, customers, and other stakeholders (Akpan & Nkanta, 2023). By sharing information on the sources and extent of renewable energy utilization, companies in the pharmaceutical sector can showcase their

commitment to reducing reliance on fossil fuels and contributing to a low-carbon economy (Okike et al., 2024). Stakeholders increasingly value organizations that prioritize sustainable practices and demonstrate tangible efforts to address climate change issues. According to Asuquo (2023), make-up design is one of the key components in the unique experience associated with performances and the vital tool for theatrical productions, film-making, social celebrations, festival and cultural promotion.

In addition to reputational benefits, renewable energy consumption disclosure can also have a positive impact on the financial performance of listed pharmaceutical firms in Nigeria (Alkebsee, 2024). Investing in renewable energy technologies and transitioning towards clean energy sources can lead to cost savings through reduced energy expenses, improved operational efficiency, and potential incentives or tax benefits for adopting sustainable practices. By publicly disclosing their renewable energy consumption data and showcasing their efforts to minimize carbon emissions, pharmaceutical companies can potentially attract socially responsible investors who prioritize environmental considerations in their investment decisions (Samuel et al., 2024). Ultimately, integrating renewable energy consumption disclosure into their reporting practices can not only enhance the environmental footprint of pharmaceutical firms but also contribute to long-term financial resilience and competitiveness in a rapidly evolving market landscape (Okpo et al., 2024).

Carbon footprint disclosure

Carbon footprint disclosure refers to the practice of transparently reporting and disclosing the total amount of greenhouse gas emissions produced directly and indirectly by an organization, product, service, or individual. This disclosure provides valuable insights into the environmental impact of activities and operations, helping stakeholders understand and assess the carbon footprint associated with a particular entity. By quantifying and communicating carbon footprints, organizations can raise awareness about their contribution to climate change, demonstrate accountability for their environmental impact, and drive initiatives to reduce emissions and enhance sustainability practices (Bagci et al., 2025; Emenyi et al., 2024; Samuel et al., 2024;)

In today's global context of increasing concern over climate change and environmental sustainability, carbon footprint disclosure has become a key component of corporate transparency and responsible business practices. Organizations are under growing pressure from investors, customers, regulators, and other stakeholders to measure, manage, and disclose their carbon emissions to address climate risks and contribute to global efforts to mitigate greenhouse gas emissions. Asuquo (2023) stated that however, it is no news that most make design products for obvious reasons that can be handled locally.

Carbon footprint disclosure typically involves calculating and reporting greenhouse gas emissions across different scopes, including Scope 1 (direct emissions from owned or controlled sources), Scope 2 (indirect emissions from purchased electricity, heat, or steam), and Scope 3 (other indirect emissions along the value chain). This comprehensive approach enables organizations to capture the full extent of their carbon footprint and identify opportunities for emissions reduction and sustainability improvements as reported by Akpan (2024). By engaging in carbon footprint disclosure, companies can set emission reduction targets, implement efficiency measures, invest in renewable energy, and engage with suppliers and partners to drive collective action towards a low-carbon economy (Prince et al., 2023; Okpo & Emenyi, 2023).

According to Grahn (2024) carbon footprint disclosure plays a crucial role in promoting environmental transparency, fostering sustainable business practices, and advancing the global transition to a greener and more resilient economy. Through openly sharing information on carbon emissions, organizations can demonstrate their commitment to climate action, align with international sustainability frameworks such as the Paris Agreement, and contribute to building a more sustainable future for generations to come.

Emissions trend disclosure

Emissions trend disclosure refers to the practice of providing information on the historical trajectory of greenhouse gas emissions over a specific period. This disclosure allows organizations to communicate how their emissions have changed or fluctuated over time, offering insights into their environmental performance and sustainability efforts. Dharma, (2024) added that by disclosing emissions trends, companies can demonstrate progress towards reducing greenhouse gas emissions, highlight improvements in efficiency and sustainability practices, and showcase their commitment to addressing climate change. Stakeholders, including investors, customers, employees, and regulators, can use this information to assess an organization's environmental impact and track its journey towards achieving emission reduction goals.

Emissions trend disclosure typically includes data on key greenhouse gas emissions metrics, such as total emissions output, emissions intensity per unit of production, emissions by scope (Scope 1, 2, and 3), and progress towards emission reduction targets. Organizations may present this information in various formats, such as annual reports, sustainability reports, corporate social responsibility disclosures, or dedicated environmental impact assessments as x-rayed (Prince et al., 2023; Okpo et al., 2024; Akpan & Nkanta, 2023).

Carnini et al. (2022) documented that providing transparency on emissions trends, companies can enhance accountability, build trust with stakeholders, and drive continuous improvement in their environmental performance. Monitoring and disclosing emissions trends also enable organizations to identify areas for further emissions reduction, implement targeted sustainability initiatives, and align with global efforts to combat climate change. Emissions trend disclosure serves as a valuable tool for promoting corporate sustainability, fostering responsible environmental stewardship, and contributing to a more sustainable and low-carbon economy (Samuel et al., 2024; Okpo & Emenyi, 2023; Prince et al., 2023).

FINANCIAL PERFORMANCE

Financial performance is the measurement and evaluation of a company's financial health, stability, and profitability over a specific period. It encompasses various aspects of a company's financial activities, including revenue generation, expense management, asset utilization, and cash flow management. Financial performance is a critical indicator of a company's ability to create value for its shareholders, meet its financial obligations, and sustain its operations over time (Philips). In the context of listed pharmaceutical firms in Nigeria, financial performance is a key metric for evaluating their overall success and competitiveness in the industry as opined by Rennebooy et al. (2008).

Financial performance is typically measured using various financial metrics, including profitability ratios, efficiency ratios, liquidity ratios, and solvency ratios. Profitability ratios, such as return on equity (ROE) and return on assets (ROA), provide insight into a company's ability to generate profits from its investments and operations (Santos, 2011). Efficiency ratios, such as asset turnover and inventory turnover, measure a company's ability to utilize

its assets and manage its operations efficiently. Liquidity ratios, such as the current ratio and quick ratio, evaluate a company's ability to meet its short-term financial obligations. Solvency ratios, such as the debt-to-equity ratio and interest coverage ratio, assess a company's ability to meet its long-term financial obligations and manage its debt burden.

Pietro et al. (2023) responded that in greenhouse gas emission disclosure, financial performance is an important consideration because it can be impacted by a company's environmental performance and sustainability practices. Companies that prioritize sustainability and disclose their greenhouse gas emissions may experience improved financial performance due to cost savings, enhanced reputation, and increased access to capital. On the other hand, companies that neglect their environmental responsibilities may face financial penalties, reputational damage, and decreased competitiveness. Therefore, examining the relationship between greenhouse gas emission disclosure and financial performance can provide valuable insights into the financial implications of sustainability practices and environmental disclosure (Emenyi et al., 2024; Wagner, 2015).

Gross profit margin

Gross profit margin is a financial metric that represents the percentage of revenue that exceeds the cost of goods sold. In the context of greenhouse gas emission disclosure and financial performance of listed pharmaceutical firms in Nigeria, understanding the concept of gross profit margin is crucial. Gross profit margin is a key financial metric that reflects a company's profitability and operational efficiency (Chen, 2023). It represents the percentage of revenue that exceeds the cost of goods sold, providing insight into how effectively a company is utilizing its resources to generate profits. For pharmaceutical firms in Nigeria, maintaining a healthy gross profit margin is essential for sustaining financial health and driving sustainable growth (Desai et l., 2022). A high gross profit margin indicates that the company is able to efficiently produce and sell its products while covering its production costs, which are particularly important in an industry like pharmaceuticals, where research and development expenses are significant as stated by Gianni et al. (2022).

Baboukardos et al. (2022) responded that the relationship between greenhouse gas emission disclosure and the financial performance of pharmaceutical firms in Nigeria can be closely tied to their gross profit margin. According to Salehi et al., (2022), disclosing their greenhouse gas emissions, pharmaceutical companies not only showcase their environmental responsibility but also signal their commitment to sustainability practices that can impact their financial performance. Implementing measures to reduce greenhouse gas emissions, such as energy-efficient operations and transitioning to renewable energy sources, can lead to cost savings and operational efficiencies that directly contribute to improving the company's gross profit margin (Olagunju & Ajiboye, 2022; Emenyi et al., 2024). Additionally, disclosing greenhouse gas emissions can enhance the company's reputation among environmentally conscious investors and consumers, potentially attracting new investment opportunities and increasing market competitiveness. Therefore, the concept of gross profit margin is intricately linked to the broader discussion of greenhouse gas emission disclosure and financial performance of pharmaceutical firms in Nigeria, highlighting the importance of sustainability practices in driving both environmental and economic outcomes as opined by Choi and Luo, (2021) alongside Kurnia et al. (2021).

Relationship between greenhouse gas emission disclosure and gross profit margin

The relationship between greenhouse gas emission disclosure and gross profit margin is a critical area of investigation, particularly in the context of listed pharmaceutical firms in Nigeria. Greenhouse gas emission disclosure refers to the practice of companies providing information about their greenhouse gas emissions, which can have significant implications for their financial performance. On the other hand, gross profit margin is a key financial metric that measures a company's profitability, calculated as the difference between revenue and the cost of goods sold, expressed as a percentage of revenue. According to Gianni et al. (2022), the disclosure of greenhouse gas emissions can have a positive impact on a company's gross profit margin, as it can lead to cost savings and improved operational efficiency. For instance, companies that disclose their greenhouse gas emissions may be more likely to identify areas for energy efficiency and cost reduction, which can lead to lower costs and higher profitability (Saraswati et al., 2021; Samuel et al., 2024).

Companies that disclose their greenhouse gas emissions may be viewed more favorably by stakeholders, including investors and customers, which can lead to increased revenue and market share as deposited by Pedron et al. (2021). In the pharmaceutical industry, companies that prioritize sustainability and disclose their greenhouse gas emissions may be better positioned to capitalize on emerging trends and opportunities, such as the growing demand for eco-friendly and sustainable products (Alessi et al., 2020; Okpo & Emenyi, 2023).

The connection between greenhouse gas emission disclosure and gross profit margin is also influenced by the regulatory environment and stakeholder expectations as reported by Akpan and Nkanta (2023). In Nigeria, listed pharmaceutical firms are subject to various regulations and guidelines related to environmental disclosure and sustainability reporting. Companies that disclose their greenhouse gas emissions and demonstrate a commitment to sustainability may be viewed as more responsible and attractive to investors, which can lead to improved financial performance, including higher gross profit margins (Okpo et al., 2024; Prince et al., 2023; Okpo, 2020; Akpan, 2024). Furthermore, the disclosure of greenhouse gas emissions can also help companies to identify areas for innovation and improvement, which can lead to the development of new products and services, and increased revenue and profitability (Saraswati et al., 2021).

Emission intensity disclosure and gross profit margin

The relationship between emission intensity disclosure and gross profit margin for listed pharmaceutical firms in Nigeria is intricate and multifaceted. By disclosing their emission intensity levels, pharmaceutical companies can demonstrate their commitment to environmental sustainability, which can positively impact their reputation among investors, shareholders, and the general public (Akpan & Simeon, 2021; Emenyi et al., 2024; Samuel et al., 2024; Okpo & Emenyi, 2023). A strong focus on reducing greenhouse gas emissions often goes hand in hand with implementing energy-efficient practices, waste reduction strategies, and sustainable sourcing methods, all of which can lead to cost savings and operational efficiency improvements (Emeh & Eze, 2022). This, in turn, can contribute to higher gross profit margins as companies streamline their operations, reduce resource wastage, and enhance overall productivity. Yu et al., (2022) responded that failing to disclose or address high emission intensity levels can have detrimental effects on a pharmaceutical firm's financial performance.

In today's increasingly environmentally conscious world, investors and consumers are placing greater importance on corporate social responsibility and sustainable business

practices (Emmanuel et al., 2023). As such, companies that neglect to disclose or effectively mitigate their greenhouse gas emissions may face reputational damage, loss of investor confidence, and decreased market competitiveness (Santos, 2011). This can ultimately impact their gross profit margins as stakeholders may view them as less reliable, ethical, or forward-thinking compared to their peers who are actively working towards environmental sustainability as reported by Agbo et al., (2024). Therefore, there exists a crucial link between emission intensity disclosure and gross profit margin for pharmaceutical firms in Nigeria, highlighting the significance of integrating environmental considerations into business strategies for long-term success and stakeholder value creation.

Energy efficiency disclosure and gross profit margin

The connectives between energy efficiency disclosure and gross profit margin are a critical aspect of a company's financial performance, particularly in the pharmaceutical industry where energy consumption is a significant cost component. Energy efficiency disclosure refers to the transparent reporting of a company's energy consumption and conservation efforts, which can have a direct impact on its financial performance (Dharma et al., 2024; Akpan & Simeon, 2021). Choi and Luo (2021), stated that by disclosing energy efficiency information, companies can demonstrate their commitment to reducing energy consumption and costs, which can lead to improved profitability. Specifically, energy efficiency disclosure can positively impact gross profit margin by reducing energy-related costs, such as fuel and electricity expenses, which are typically significant components of a company's cost of goods sold.

A company's gross profit margin is calculated by subtracting the cost of goods sold from revenue and dividing the result by revenue. By reducing energy-related costs through energy efficiency measures, companies can decrease their cost of goods sold and increase their gross profit margin as propounded by Grahn (2024). Moreover, energy efficiency disclosure can also lead to improved operational efficiency, reduced waste, and enhanced reputation, all of which can contribute to increased revenue and profitability (Bedi & Singh, 2024; Emenyi et al., 2024). In the context of listed pharmaceutical firms in Nigeria, energy efficiency disclosure can be a critical factor in driving financial performance, particularly in a sector where energy costs can be high due to reliance on generators and other backup power sources (Prince et al., 2023). By prioritizing energy efficiency disclosure, pharmaceutical companies in Nigeria can unlock opportunities for cost savings, improved profitability, and enhanced sustainability as stated by Nurlis, (2019).

Renewable energy consumption disclosure and gross profit margin

The relationship between renewable energy consumption disclosure and gross profit margin for listed pharmaceutical firms in Nigeria is a vital aspect of sustainable business practices and financial performance (Chen et al., 2023). By disclosing their renewable energy consumption levels, pharmaceutical companies can showcase their commitment to reducing carbon emissions, transitioning to cleaner energy sources, and contributing to environmental preservation (Ajayi & Anjorin, 2020; Samuel et al., 2024). Embracing renewable energy not only aligns with global sustainability goals but also presents opportunities for cost savings and operational efficiencies (Prince et al., 2023). Philips, (2003) recorded that investing in renewable energy solutions such as solar power, wind energy, or biomass can help pharmaceutical firms reduce their reliance on fossil fuels, decrease energy expenses, and potentially boost their bottom line through long-term energy cost stability. This shift towards renewable energy consumption can also enhance the company's reputation, attract environmentally conscious investors, and improve stakeholder trust, all of which can

positively influence the firm's overall financial performance and gross profit margin (Okpo et al., 2024; Emenyi et al., 2024).

Noh and Park (2023) x-rayed that neglecting to disclose or actively adopt renewable energy consumption practices can pose risks to the financial performance of pharmaceutical companies in Nigeria. In today's dynamic business landscape, where environmental responsibility is increasingly valued by investors, customers, and regulatory bodies, firms that ignore the transition to renewable energy may face negative repercussions (Santos, 2011). Failure to embrace renewable energy consumption may lead to higher energy costs, regulatory non-compliance penalties, and reputational damage as stakeholders view the company as lagging in sustainability efforts (Agbo and Egbunike, 2024). Such consequences can put pressure on the firm's gross profit margin by increasing operational expenses, reducing competitiveness, and limiting access to capital investments as postulated by Agbo and Egbunike, (2024). Therefore, the disclosure of renewable energy consumption in the pharmaceutical sector in Nigeria is not only crucial for environmental stewardship but also plays a significant role in shaping the financial performance and profitability of listed firms in the industry (Chen et al., 2023; Samuel et al., 2024; Okpo & Emenyi, 2023).

Carbon footprint disclosure and gross profit margin

The relationship between carbon footprint disclosure and gross profit margin of listed pharmaceutical firms in Nigeria is complex and multifaceted. Firms that prioritize transparency in reporting their greenhouse gas emissions through carbon footprint disclosure may experience a positive impact on their gross profit margin due to enhanced reputation and stakeholder trust, leading to increased customer loyalty and retention, which in turn can drive sales and revenue growth, while also attracting environmentally conscious investors and top talent, ultimately contributing to improved financial performance as x-rayed by Bagci et al. (2025). Metaphor is a name directly given to something in an indirect reference as stated by (Stephen & Mandu). As stakeholders increasingly demand sustainable practices and transparency from companies, particularly in industries with significant environmental impact like pharmaceuticals, where the disclosure of carbon footprint can serve as a key indicator of a firm's commitment to sustainability and environmental responsibility, influencing stakeholder perceptions and decisions that can have a direct impact on the firm's financial bottom line, including gross profit margin (Menike, 2020; Akpan & Simeon, 2021; Emenyi et al., 2024).

Emissions trend disclosure and gross profit margin

Akpan (2024) opined that the relationship between emissions trend disclosure and gross profit margin of listed pharmaceutical firms in Nigeria is multifaceted and interconnected. When pharmaceutical companies disclose their emissions trends, it signifies a commitment to transparency, sustainability, and environmental responsibility, which can positively impact their reputation and stakeholder trust. This enhanced reputation may attract environmentally conscious investors, potentially leading to increased investment and improved financial performance. Moreover, by disclosing emissions trends, pharmaceutical firms can identify opportunities for emissions reduction and operational efficiency, potentially reducing costs and enhancing profitability. Stephen and Mandu (2025) opined that describing a people based on their language is a common knowledge. The disclosure of emissions trends by listed pharmaceutical firms in Nigeria can have a significant influence on their gross profit margins through improved investor confidence, cost savings from efficiency gains, and strategic positioning in a market increasingly valuing sustainability practice (Emenyi et al., 2024; Luu et al., 2025).

THEORETICAL FRAMEWORK

The relationship between greenhouse gas emission disclosure and financial performance of listed pharmaceutical firms in Nigeria cannot be launched without taking cognizance note of some important theoretical model. However, in the course of this work, the Institutional theory by Meyer and Brian Rowan, (1977), Stakeholder theory by Edward Freeman in 1984 and the signaling theory by Spence, (1973) were reviewed with institutional theory being the anchor theory because of its detailed explanation of how external pressures could shape corporate behavior.

The institutional theory by Meyer and Rowan, (1977)

The institutional theory was propounded by Meyer and Rowan in 1977.The theory posits that companies are influenced by institutional pressures, including regulatory requirements, social norms, and industry expectations. The theory suggests that these companies are subject to various institutional pressures that shape their disclosure practices and financial performance. For instance, the Nigerian Exchange group has introduced sustainability disclosure guidelines that encourage listed companies, including pharmaceutical firms, to disclose their environmental, social, and governance (ESG) performance, including greenhouse gas emissions. This regulatory pressure can influence pharmaceutical firms to prioritize greenhouse gas emission disclosure, which can, in turn, impact their financial performance (Eneh & Eniola, 2019).

The significance of this theory lies in its ability to explain how external pressures shape corporate behavior and disclosure practices. By examining the institutional context in which pharmaceutical firms operate, researchers can gain insights into the factors that drive greenhouse gas emission disclosure and its subsequent impact on financial performance. Moses and Clinton, (2023) highlights the importance of considering the broader social and regulatory environment in which companies operate, rather than solely focusing on internal factors such as management decisions or financial ratios.

The stakeholder theory by Edward Freeman, (1984).

Freeman (1984) suggests that companies have a moral obligation to disclose their greenhouse gas emissions, as this information is crucial for stakeholders, including investors, customers, and the wider community, to make informed decisions. Freeman (1984) emphasizes that companies must balance the interests of various stakeholders, including those with environmental concerns, to ensure long-term sustainability and financial success. By disclosing greenhouse gas emissions, pharmaceutical firms in Nigeria can demonstrate their commitment to environmental sustainability, which can lead to improved financial performance. This is because stakeholders, including investors and customers, are increasingly prioritizing environmental considerations in their decision-making, and companies that demonstrate a strong commitment to sustainability are more likely to attract investment, talent, and customers.

The significance of this model lies in its emphasis on the importance of considering the interests of all stakeholders, including those affected by environmental impact. By adopting a stakeholder approach, pharmaceutical firms in Nigeria can better manage their environmental impact, improve their financial performance, and contribute to a more sustainable future as seen in Otti and Schieman, (2023). This theory also provides a framework for understanding the complex relationships between stakeholder interests,

environmental sustainability, and financial performance, and highlights the need for companies to prioritize transparency and disclosure in their environmental reporting.

The signaling theory by Michael Spence, (1973)

The signaling theory was propounded by Spence in 1973. The theory posited that greenhouse gas (GHG) emission disclosures can serve as a signal to stakeholders, including investors, customers, and regulators, about a pharmaceutical firm's commitment to sustainability and environmental responsibility, which can positively impact its gross profit margin in Nigeria by enhancing its reputation, reducing regulatory risks, and attracting environmentally conscious investors and customers. This can lead to increased sales and revenue growth, as well as improved access to capital and talent, while firms with poor GHG emission disclosure practices may be perceived as being less committed to sustainability, potentially leading to reputational damage, regulatory scrutiny, and decreased investor confidence, negatively impacting their gross profit margin (Luu et al., 2025).

This theory is important to the study because it highlights the potential financial benefits of GHG emission disclosures and provides a framework for understanding how these disclosures can influence stakeholder perceptions and decisions that can have a direct impact on a firm's financial performance, making it a relevant and useful theory for examining the relationship between GHG emission disclosures and gross profit margin of pharmaceutical firms in Nigeria.

EMPIRICAL REVIEW

Empirical research is defined as any study whose conclusions are exclusively derived from concrete evidence. It is guided by scientific experimentation.

Mamatzakis and Tzouvanas, (2025) assessed greenhouse gas emissions and quality of financial reporting: Evidence from the EU. Our study delves into the association between greenhouse gas (GHG) emissions and the quality of financial reporting. Our investigation focuses on understanding how firms' GHG emissions would impact discretionary accruals and real earnings management. We also test the moderating role of a large board size, and CEO as a board member. Finally, we conduct various robustness checks to ensure the robustness and validity of our findings. We conducted a study on 476 European companies across 17 countries and various industries between 2005 and 2018. We use panel data estimations, and multiple methods to account for emissions and address endogeneity issues in our tests. Our findings indicate that greenhouse gas emissions increase earnings management, as measured through discretionary accruals and real earnings management. This leads to lower quality financial reporting. We also find that a larger board size moderates the relationship between GHG emissions and financial reporting, resulting in greater financial transparency. Our findings provide evidence that firms' GHG emissions, despite stricter emission regulations in the European Union (EU), would be positively associated with real earnings management. This finding calls for more research in different regions to understand if this is a global trend.

Citraningtyas et al. (2025) investigated the impact of greenhouse gas emissions disclosure and institutional ownership on firm value: Evidence from mining industry in Indonesia. In the mining industry, handling and mitigating greenhouse gas emissions (GHG) is crucial to maintaining business and environmental sustainability. A large portion of the world's carbon dioxide emissions come from the mining industry as a result of deforestation

and heavy machinery exploration run by fossil fuels in the mining site. This study aims to investigate whether GHG emission reporting, as well as institutionally owned share ownership, would increase the firm's value in the eyes of capital market investors. A panel data regression of the one hundred and sixty-eight listed mining companies on Indonesia's capital market in 2019–2023 reveals that GHG emissions reporting and institutional ownership are likely to increase firm value. The results suggest that investors would value companies with higher GHG emissions and institutional ownership. This study advises mining company management that, although GHG emission mitigation action and reporting and dealing with institutional investors are costly, they will boost company image and value in the capital market.

Abdalla et al. (2025) investigated the effect of audit committee effectiveness (ACE), size of internal audits (IAS), and internal audit outsourcing (IAO) on greenhouse gas (GHG) emissions disclosure from the perspectives of stakeholder theory in Malaysia. The current study collected and analyzed data based on 285 observations of plantations listed in Bursa Malaysia from 2016 to 2021. The effects of ACE, IAS, and IAO on the disclosure of GHG emissions are observed using a panel data regression model. The study findings revealed a significant positive relationship between ACE, IAS, and GHG emission disclosure. Based on these results, firms that established an effective audit committee and extended their internal audit teams tended to report more GHG emissions information than other firms. Moreover, to the best of our knowledge, this is the first study to consider IAS and IAO when evaluating GHG emissions disclosure. Further, this study assesses firms with higher levels of GHG emissions disclosure using a new global reporting initiative and the Bursa Malaysia Sustainability Reporting Guide based on the GHG emissions disclosure checklist. This expands the existing literature on GHG emission disclosure. The current study may not accurately portray the state of GHG emission disclosure in Malaysia because of its exclusive focus on the plantation sector. As a result, future studies should examine GHG emissions disclosure in other sectors to provide new insights into GHG emissions disclosure in developing countries.

Luu et al. (2025) examined the impact of the mandatory greenhouse gas emissions reporting program (GHGRP) on corporate greenwashing behaviour. Utilising the GHGRP in the United States as a quasi-natural experiment, we perform a difference-in-difference analysis to a panel dataset of 2731 publicly listed US firms from 2007 to 2022. The data consist of annual observations of firm-level variables, including ESG performance and disclosure metrics, financial characteristics, and environmental innovation indicators. Our results reveal a notable reduction in greenwashing behaviour following the adoption of the GHGRP, suggesting that increased transparency and accountability discourage deceptive disclosure practices. A decomposition analysis shows that the GHGRP motivates firms to improve actual ESG performance while curbing inflated ESG claims. Larger and more profitable firms exhibit a more significant decrease in greenwashing, indicating that those under greater public scrutiny respond more strongly to regulatory oversight. Additionally, firms with higher levels of environmental innovation demonstrate a greater reduction in greenwashing post-GHGRP adoption, reflecting an alignment between sustainability commitments and corporate culture. This study offers valuable insights for firm managers, investors, and policymakers on leveraging the GHGRP framework to promote transparency in corporate reporting practices.

Kilian, (2025) carried out an investigation on the disclosure of greenhouse gases by companies: Differences between Africa and the United States of America. On 6 March 2024, the Securities and Exchange Commission (SEC) proposed and adopted an environmental

disclosure rule (Enhancement and Standardisation of Climate-Related Disclosures for Investors). The rule and its explanation consist of 886 pages; consequently, this article attempts to illustrate briefly the environmental metrics or factors that comprise this rule and which US companies have to report on in their audited financial statements. The SEC metrics for calculating and reporting greenhouse gas (GHG) emissions are largely based on the Greenhouse Gas Protocol and the Task Force on Climate Related Financial Disclosures (TCFD). In Africa, the Johannesburg Stock Exchange (JSE) in South Africa has introduced similar environmental metrics for GHG disclosures. In the future, South Africa's Climate Change Bill, 2022, will empower the Minister to issue regulations that promote standardised environmental metrics for companies, similar to the SEC rule. This article also briefly focuses on the Corporate Sustainability Reporting Directive (CSRD).

Hewagama et al. (2025) aimed to analyse carbon emissions' (CE) impact on New Zealand-listed entities' firm performance before adopting legislation for mandatory climate disclosures. The study uses a fixed effects regression model to examine the impact of CE on Tobin's Q, the return on assets (ROA) and the return on equity (ROE). The sample comprised 97 New Zealand Stock Exchange companies, representing 90% of total market capitalisation. CE are significantly and negatively associated with firm performance, as measured by Tobin's Q (a market-based measure). The negative impact is significant, with an estimated 48.74% decline in the mean Tobin's Q, highlighting the substantial effect of CE on firm valuation. However, CE shows no significant statistical association with the accounting-based measures of ROA or ROE. The results also show that in a voluntary reporting regime, companies disclosing emissions are penalised more with reduced firm value than those that do not disclose. The study serves as a reference point to examine the impact of CE on the firm performance of New Zealand-listed entities before the mandatory climate disclosures came into effect. The results support mandatory disclosure to create transparency and competitiveness in financial markets in relation to CE.

Prasetyaningsih et al. (2025) examined the influence of green accounting and carbon emission disclosure on company value. In the era of globalization and increased awareness of the impacts of climate change, sustainable development has become one of the main concerns at the global level. One of them is the disclosure of carbon emission disclosure and the application of green accounting in the company's operational process as an effort to overcome environmental problems. This study aims to determine whether green accounting & carbon emission disclosure has a positive effect on firm value. The study uses secondary data obtained from annual reports and corporate sustainability reports for the 2019-2023 period. Companies with the energy sector listed on the Indonesia Stock Exchange in 2019-2023 are the criteria for this research data. Data processing using Statistical Package for Social Science. The results showed that the application of green accounting & carbon emission disclosure has no influence on firm value. The ineffectiveness of green accounting and carbon emission disclosure on firm value is likely due to the proxies used in this study that do not fully represent the true indicators of green accounting and carbon emission disclosure. Future research is recommended to use other proxies that are more relevant in measuring green accounting and disclosure of carbon emissions.

Zhang et al. (2025) investigated the impact of greenhouse gas (GHG) emission disclosure on firm outcomes remains contested, highlighting the need to account for organizational contingencies when evaluating its effects. This study examines how leadership gender diversity specifically board gender diversity and top management team gender diversity moderates the relationship between GHG disclosure and firm systematic risk. Using a comprehensive panel of 6966 firm-year observations from 2010 to 2020 and applying

robust estimation techniques, we identify gender diversity in leadership as a critical contingent factor. In particular, board gender diversity significantly moderates the GHG disclosure–risk relationship: firms with greater gender diversity in the boardroom experience a stronger risk-reducing effect from both core and extended GHG disclosures, whereas, firms with lower board gender diversity exhibit heightened systematic risk in response to disclosure. These findings contribute to the sustainability literature, resource dependence theory, and upper echelons theory by demonstrating that the impact of environmental disclosure is conditional on leadership composition. The study offers actionable insights for firms seeking to align ESG strategies with governance practices and for investors evaluating the credibility and risk-mitigating potential of corporate sustainability disclosures.

Alkebsee et al. (2025) examined the impact of GHG assurance on firms' carbon emissions performance (CEP) regarding curbing carbon emissions and the effect on such by the GHG assurance provider's affiliation and reputation. It also explores whether the affiliation and reputation of GHG assurance providers imply the relationship between GHG assurance and the firm's CEP. Further, this study examines the moderating effect of the country's development level on the relationship. Based on a sample of international firms from 56 countries spanning the period from 2012 to 2020, this study utilizes the ordinary least squares (OLS) regression. We also run the OLS regression at times t+1 and t+2 to verify the baseline results. To address the endogeneity concerns arising from self-selection bias and the causality effect, this study applies the generalized method of moment (GMM) and the Heckman test. This study finds that GHG assurance leads to better CEP by firms. We also find that engaging with accounting assurance providers leads firms to a better CEP than non-accounting assurance providers. Our results show that Big Four auditors can help firms decrease carbon emissions. We also find that the positive effect of GHG assurance is prevalent in firms operating in developed countries. Our study only considers the influence of the assuror's reputation and affiliation on CEP without examining other factors that may influence the quality of assurance services provided. Our study provides a practical implication related to the influence of a GHG assurance provider's affiliation and reputation globally by providing evidence that accounting and Big Four assurance providers do play a significant role in a firm's carbon emission performance. This study offers great insights into the GHG assurance impact on CEP with the interplay between the assuror's affiliation and reputation and the country's development.

Bagci et al. (2025) explored the impact of agricultural support policies on greenhouse gas emissions in BRICS-T countries (Brazil, Russia, India, China, South Africa, and Türkiye), emphasizing the role of financial development, market structures, and institutions. Using annual data from 2000 to 2021, the research employs advanced panel time-series econometric techniques, including the Augmented Mean Group (AMG) estimator and, the Westerlund and Edgerton cointegration test, to assess long-term relationships. Findings indicate that economic growth significantly contributes to rising agricultural emissions, while the influence of financial development varies across countries. In Türkiye and South Africa, financial institutions play a crucial role in promoting sustainable agricultural investments, thereby helping to mitigate emissions. Policy recommendations include redesigning subsidy mechanisms to support eco-friendly farming, integrating carbon pricing into agricultural strategies, and strengthening financial institutions' role in green investments. By examining the intersection of agriculture, emissions, and finance, this study offers valuable insights for sustainable policy development in emerging economies.

Yang et al. (2025) focused on assessing greenhouse gas emission factors in wastewater treatment. In the context of combating climate change, accurately evaluating the

environmental impact of wastewater treatment is of great significance for sustainable development. This study centers on two methods for determining greenhouse gas emission factors in wastewater treatment. One approach calculates per-unit-volume emission factors by utilizing measured greenhouse gas data and the volume of treated water. When measured data are unavailable, an alternative method is adopted to obtain empirical values. Wastewater treatment plant A, with its relatively large scale and certain monitoring capabilities, can acquire partially measured data on greenhouse gas emissions from its treatment units. Thus, both the emission factor measurement method and the empirical value calculation method were utilized to analyze the greenhouse gas emission characteristics and compare the differences in accounting results. For this plant, the average measured values of CH_4 and N_2O emissions were 0.0304 kg CO_2-eq/m3 and 0.0343 kg CO_2-eq/m3, respectively. In contrast, the empirical values were 0.0505 kg CO_2-eq/m3 for CH_4 and 0.0711 kg CO_2-eq/m3 for N_2O. Wastewater treatment plant B, due to its smaller scale, currently lacks the conditions for on-site greenhouse gas measurement. Consequently, only the empirical value calculation method could be used to analyze its greenhouse gas emission characteristics. Its empirical CH_4 and N_2O values were 0.0645 kg CO_2-eq/m3 and 0.1135 kg CO_2-eq/m3, respectively.

Matthews et al. (2024) studied carbon disclosure, greenhouse gas emissions and market value of FTSE 350 firms: Evidence from voluntary carbon disclosers versus non-disclosers. In 2013, a carbon disclosure mandate was adopted by UK-listed companies. This motivated our study to explore the effects of the 2013 carbon disclosure regulation (CDR) and Greenhouse Gas (GHG) emissions on firms' market value for voluntary disclosers versus non-disclosers pre- and post-2013 CDR. Using a sample of FTSE 350 firms in a short (2010–2016) and long window (2010–2020), our difference-in-differences design shows a beneficial (adverse) effect of the 2013 CDR on market value for voluntary carbon disclosers (non-disclosers). Also, we document the negative impact of GHG emissions on market value after the 2013 CDR for voluntary disclosers. In contrast, a somewhat positive GHG-market value nexus is noted in the case of non-disclosers post-2013 CDR. Our evidence suggests that voluntary carbon disclosers are heavier GHG emitters and, hence, bear much higher environmental risks/liabilities, a negative attribute that became ever more taxing to their market value after the 2013 CDR.

Dharma et al., (2024) conducted a study on Profitability and market value effect on carbon emission disclosures: The moderating role of environmental performance. Climate change is an issue that is of concern to the global public and scientific community. There is a close relationship between climate change and carbon emissions, which are the primary cause of global warming. Reporting on carbon emissions is essential for corporate accountability to stakeholders when evaluating a company's financial and non-financial performance. Good management of carbon emissions will enhance the company's reputation. This study analyses the impact of company profitability and market value on the disclosure of carbon emissions, with environmental performance serving as a moderating variable in the context of Indonesian public companies. This study concludes that: (1) There is no significant impact on profitability, as measured by Return on Assets, on Carbon Emission Disclosure; (2) The study finds that there is a statistically significant positive relationship between market value, measured by Tobin's Q, and the level of carbon emission disclosure. This relationship is significant at a 5% significance level; (3) The moderating effect of environmental performance on the relationship between profitability, as measured by return on assets, and carbon emission disclosure is found to be insignificant; (4) The significance level of 10% indicates that the relationship between environmental performance, as a measure of a company's environmental practices, and market value, as represented by Tobin's Q, is strengthened concerning the disclosure of carbon emissions. This research can contribute to

developing accounting knowledge to close gaps in the body of knowledge regarding the disclosure of carbon emissions in developing nations, particularly Indonesia.

Agbo et al. (2024) conducted a research on greenhouse gas emission and energy consumption disclosure on market competitiveness of listed non-financial firms in Nigeria. This study examined the effect of Greenhouse Gas emission (GHGD) and energy consumption disclosure (ECDI) on the market competitiveness of listed non-financial firms on the Nigerian Exchange Group (NGX).Market competitiveness was proxied using the market-to-book ratio (MTBR).The study anchored on two theories: 'agency theory' and 'stakeholder theory'. The exposit facto research design was used and a purposive sample of thirty-eight non-financial firms listed on the NGX during the study period were selected as the sample. This study utilised secondary sources of data, from annual financial statements retrieved from the Machame Ratios® database. The data were analysed using multiple regression techniques. The results showed a significant negative effect of the GHGD on MTBR (p=0.0164); while ECDI had a non-significant positive on the MTBR (p=0.1140) of listed non-financial firms. The study concludes that GHG emissions and energy consumption disclosure affect the market competitiveness of listed non-financial firms in Nigeria. The study recommends that management and boards of non-financial firms should strive for increased transparency and disclosure of Greenhouse Gas emissions by companies. Companies can enhance their reputation among environmentally conscious investors by disclosing their GHG emissions, demonstrating their commitment to sustainability and climate responsibility. The management of non-financial firms should improve the energy consumption disclosure of their activities. Companies can enhance investor trust and confidence by disclosing their energy consumption levels and providing valuable information about their operational efficiency and resource management practices.

Okike et al. (2024) conducted research on emission disclosure and market value added of oil and gas firms in Nigeria. This study assessed the nexus between emission disclosure and the market value added of quoted oil and gas firms in Nigeria for the period of eleven (11) years spanning from 2012 - 2022. Carbon Disclosure, Nitrogen Oxides Disclosure, and Sulphur Oxides Disclosure were used to proxy Environmental Disclosure whereas Market Value Added served as the dependent variable. In line with the objectives of the study, three hypotheses were formulated. An ex-post facto research design was employed. Six (6) quoted oil and gas firms constituted the sample size of this study. The secondary data were extracted from the annual reports and accounts of the sampled firms and were analysed via E-Views 9.0 statistical software and Panel Least Square (PLS) regression analysis. Findings from the empirical analysis revealed that there is a significant relationship between Carbon Disclosure, Nitrogen Oxides Disclosure and Sulphur Oxides Disclosure and Market Value Added of quoted oil and gas firms in Nigeria at the 5% level of significance. Inter alia, firms should take the issue of emission disclosure seriously to increase the confidence of the public in their operations which translates to healthy the performance of the industry, and relevant agencies in Nigeria should strengthen their monitoring and oversight functions on the compliance level of firms with environmental frameworks.

Aharon et al.(2024) empirically examined greenhouse gas emissions and the stability of equity markets. We test the impact of GHG emissions on equity markets' volatility. Our results confirm that CO2 and other greenhouse gases emissions such as agricultural nitrous oxide, and methane emissions are associated with increased stock market volatility. This relationship holds across different measures of volatility, emissions, and specifications using nearly 30 years' worth of index-level data from stock exchanges across 50 countries. These findings lend support to the notion that carbon risk is priced into financial markets, and that

green finance could promote more stable global equity markets in the future and thereby foster a more sustainable economic system.

Grahn (2024) empirically examined greenhouse gas disclosure: Evidence from private firms. Existing literature on greenhouse gas (GHG) emissions disclosure has paid little attention to private firms, despite the fact that this type of firm is responsible for significant GHG emissions. This study empirically analyzes the GHG disclosure of German private firms. The results suggest that more pronounced information asymmetries due to a more dispersed ownership structure and/or multiple bank relationships are associated with more extensive GHG disclosure. This aligns with arguments from agency and stakeholder theory. While this result is not new for public firms, it is for private firms. Given the specific characteristics of this type of firms (no separation of ownership and control, private communication channels, close bank–borrower relationships), it is not a straightforward assumption that observations from public firms can be transferred to private firms one-to-one. Moreover, higher levels of actual GHG emissions are also associated with more GHG disclosure, indicating that legitimacy theory arguments hold for private firms as well.

Agbo and Egbunike (2024) investigated on climate change disclosure and financial performance of quoted oil & gas firms in Nigeria. Prior research has demonstrated the critical role that climate change disclosure plays in solving global sustainability challenges connected to human existence and the long-term viability of businesses. The goal of this study is to add to the existing literature on the impact of climate change-related disclosure on the financial performance of oil and gas companies in Nigeria. The study adopted an ex post facto research design, and the final sample consisted of eight oil and gas companies listed on the NGX for the year 2012-2021. The final sample consisted of a balanced panel of 80 firm-year observations. The dependent variable was Return on Assets (ROA). Data were analyzed using a multiple regression model. The findings showed a positive relationship between CCRD and ROA, which was also confirmed to be significant at the 5% significance level. The model includes leverage, audit quality, and firm size, in addition to CCRD, to account for their effect on ROA. Therefore, other factors that may affect firm performance are not included in the model. This study addresses one of the most important but less explored issues of environmental research in one of the largest economies in SSA. The data collected from the content analysis are original and provide important evidence of the impact of CCRD on firm performance. These findings encourage oil and gas companies to reduce their carbon emissions and disclose their carbon management activities.

Emenyi and Okpokpo (2023) anchored on the relationship between environmental disclosure and the quality of financial reports in Nigerian manufacturing sector. The specific objectives were to examined the relationship between environmental donations and sponsorship disclosure on the quality of financial reports among manufacturing firms in Nigeria; examined the relationship between environmental restoration disclosure on the quality of financial reports among manufacturing firms in Nigeria, accessed the relationship between environmental waste management disclosure on the quality of financial reports among manufacturing firms in Nigeria and ascertain the relationship between environmental donations and sponsorship disclosure, restoration and waste management disclosure and the quality of financial reports among manufacturing firms in Nigeria. Expost facto research design was adopted and a final sample size of 10 manufacturing firms was purposively selected for a period of 10 years. The data were collected through content analysis method. Descriptive and inferential statistics were used to analyzed collated data. Findings revealed that two out of the three components of the environmental accounting information, namely, Environmental Restoration (ER), and Environmental Donations and Sponsorship (EDS)have

no significant influence on the quality of financial reports among the manufacturing firms. Thus, the null hypothesis were accepted. The study concluded that the influence of the disclosure of accounting information about environmental restoration, and environmental donations and sponsorship on the quality of financial reports of manufacturing firms in Nigeria were insignificant. It was recommended that Standard setters and policy makers should work with the Ministry of Environment to consider introducing mandatory disclosures which are consistent.

Udomah and Emenyi (2023) delved into the impact of sustainability reporting on the financial performance of selected cement firms in Nigeria, employing an ex-post facto research design with a population comprising 10 cement firms spanning the years 2016-2020. The key findings indicated a negative and insignificant correlation between environmental reporting and the performance of cement companies in Nigeria. Conversely, economic reporting demonstrated a positive influence on the financial performance of these cement firms, while social reporting was associated with a decrease in their financial performance. The overall conclusion drawn was that sustainability reporting significantly affects the composite financial performance of healthcare companies in Nigeria. Notably, individual components of sustainability reporting did not exert a significant impact on the financial performance of cement firms. The study recommended that government policymakers enforce the compulsory inclusion of sustainability reports in the annual reports of cement companies, shifting from voluntary disclosure to mandatory reporting. Furthermore, it suggested that the management of manufacturing firms should prioritize the disclosure of economic reports, given their positive effect on performance.

Yan et al. (2023) examined the relationship between environmental disclosure and the cost of capitals, challenging theoretical expectations by exploring this dynamic within the unique context of China's new development stage, characterized by a delicate equilibrium between economic growth and environmental preservation. In the pursuit of this objective, the study constructed an environmental disclosure index and investigates its association with the costs of equity and debt capitals. In the analysis of pooled samples, the research revealed that environmental disclosure, on its own, does not significantly account for the variation in either cost. However, a nuanced understanding emerged when regulation intensity is taken into account. In the debt market, institutional investors exhibited a tendency to devalue environmental disclosure but express an appreciation for disclosure by firms with significant pollution. In contrast, within the stock market, retail investors generally responded positively to environmental disclosure. Notably, disclosure by traditionally recognized polluting firms in this market led to an increase in the cost of equity capital. This study highlighted the crucial heterogeneity between debt and equity markets and underscored the moderating role of regulation intensity in shaping the intricate relationship between environmental disclosure and the costs of capitals.

Nangih et al. (2022) examined the effect of environmental disclosures on earnings quality of listed consumer goods companies in Nigeria. The study used management efficiency as a moderating variable on the relationship between environmental disclosures and earnings quality. The study adopted the ex post facto research design, and was anchored on the legitimacy theory. Convenience sampling technique was used to determine a sample of six selected consumer goods firms listed on the Nigerian stock exchange. Data collected from published financial statements of sampled firms, for seven years (2014 to 2020) were analyzed using descriptive, correlation and Panel least square regression technique. The findings revealed that environmental sustainability disclosures had positive and significant influence on the earnings quality of consumer goods firms in Nigeria.

Kurnia et al. (2021) carried out a study on carbon emission disclosure and firm value: A study of manufacturing firms in Indonesia and Australia. This research aims to examine the effect of carbon emission disclosure on firm value in Indonesia and Australia. Research samples are 39 Indonesian manufacturing firms and 25 Australian manufacturing firms. Firm value is measured by Tobin's Q while carbon emission disclosure is measured by the carbon emission disclosure index. Based on analysis data, carbon emission disclosure in Indonesia increases firm value. It indicates carbon emission disclosure brings a competitive advantage for firms to create value. On the other hand, there is no effect of carbon emission disclosure in Australia on firm value. Carbon emission disclosure implementation is costly and leads to higher expenses and lower cash flow.

Gerged et al. (2021) investigated the correlation between corporate environmental disclosure (CED) and firm value (FV) in the Gulf Cooperation Council (GCC) countries, where CED has been experiencing growth from a previously low baseline. In contrast to prior research, largely concentrated on the developed world with a focus on single-country studies, this study took a multicounty approach, analyzing a sample of 500 firm-year observations using a 55-item unweighted environmental disclosure index. The results revealed a statistically significant and positive relationship between CED and firm value, measured by Tobin's Q (TBQ). This association remained robust when considering a weighted version of the disclosure index, individual countries, and environmental disclosure subindices. While there was some evidence of a positive link between CED and return on assets, it was comparatively weaker than the observed correlation with TBQ. Based on empirical and theoretical considerations, the study suggests that future research should give greater attention to market-based proxies when assessing the value relevance of CED, both in developed and developing countries. The study's implications suggest that managers and policymakers in GCC countries should embrace an optimistic stance towards the expansion of CED practices.

Nimanthi and Priyadarshanie (2021) researched on the impact of environmental disclosure practices on firm performance, an increasingly important global concern. This research utilized secondary data sourced from published annual reports of companies listed on the Colombo Stock Exchange (CSE). Data was collected from a sample comprising 50 companies across five sectors, spanning four consecutive financial years from 2015 to 2018. Content analysis was employed as the method for assessing the extent of environmental disclosures, with the creation of an Environmental Disclosure Index (EDI) based on the Global Reporting Initiative (GRI) Standards 2019. The study employed regression analysis for data analysis. The results indicated a significant positive relationship between environmental disclosures and firm financial performance. However, no significant relationship was observed between environmental disclosures and firm market performance.

3.0 METHODOLOGY

This particular section focused on the research design, population of the study, sample size and sampling techniques. It also shows the sources of data and method of data collection, method of data analysis, model specification as well as measurement/operationalization of the variables. This study adopted an ex-post facto research design. This design was suitable because the data for the analysis had already exist, leaving no room for the researcher to manipulate the variables under study.

The population of this study comprised of seven pharmaceutical firms listed on the floor of the Nigerian Exchange Group, from 2015 to 2024. These firms were as follows: Ekocorp PLC, Fidson Healthcare PLC, Glaxo Smithline PLC, May and Baker Nigeria PLC, Morison industries PLC, Neimeth international pharmaceuticals PLC and Pharma-Deko PLC. Refer to the table below for the list of the seven pharmaceutical firms.

The sample of the study and the population were the same. Thus, the sample size of this study was seven (7). This is because the study population was sizeable enough to handle.

Census sampling technique was adopted in selecting the required sample. However, availability of data served as the yardstick for selection. The technique enhances the selection of pharmaceutical companies that were continuously listed by Nigeria stock exchange group (NGX) during the period (2015-2024) and whose financial statements and reports are available and have been consistently submitted to Nigeria stock exchange for the period under study.

The data for the dependent and independent variables were extracted from financial reports of sampled listed pharmaceutical firms in Nigeria using contents analysis method and collated with the aid of Microsoft excel software. The panel data methodology was adopted because the study combined time series and cross-sectional data, that is, seven (7) cross-sectional observations for each year and ten-time series for each pharmaceutical firm regressor, a total of seventy (70) pooled observations.

This study utilized multiple regression to ascertain the cause-effect linkage between the dependent variable and the independent variables, as well as to evaluate the formulated hypotheses. This approach was chosen due to the presence of variances in the error term and the inability of the data to follow the standardized regression assumptions, that is, linearity, homoscedasticity, normality and independence of data. The decision was based on 5% level of significance. Accept null hypothesis (Ho) if probability value (i.e. P-value or Sig.) is greater than or equals to (≥) stated 5% level of significance (α); otherwise, reject and accept alternate hypothesis (H_1), if p-value or sig calculated is less than 5% level of significance.

The model for this work was adopted from the study of Yu et al., (2022) but modified to suit the hypotheses of this present study. Therefore, the author specified the econometric function as;

Financial performance=f(greenhouse gas emission disclosure)……..(1)

$$\mathbf{GPM}_{it} = \beta_0 + \beta_1 EID_{it} + \beta_2 EED_{it} + \beta_3 RECD_{it} + \beta_4 CFD_{it} + \beta_5 ETD_{it} + \mu_{it} \text{.....(2)}$$

Where;

GPM = Gross profit margin of listed pharmaceutical firms in Nigeria.

EID = Emission intensity disclosure of listed pharmaceutical firms in Nigeria.

EED = Energy efficiency disclosure of listed pharmaceutical firms in Nigeria.

RECD= Renewable energy consumption disclosure of listed pharmaceutical firms

CFD = Carbon footprint disclosure of listed pharmaceutical firms in Nigeria.

ETD = Emissions trend disclosure of listed pharmaceutical firms in Nigeria.

β_0= Intercept or regression constant.

$\beta_{1...}...\beta_5$ = Regression coefficients to be estimated.

μ = Stochastic error term.

$_{it}$ = Error term.

Measurement/operationalization of variables

Table 3.1 below depicts the measurement of the variables defined in the model above

Table 3.1 Measurement of variables

Concept	Proxy	Measurement	Source	Apriori Expectation
Greenhouse gas emissions disclosure *(Independent variable)*	Emission intensity disclosure (EID)	Emission intensity disclosure index using researcher's compiled checklist.	Zhou and Pan, (2022). Okike et al., (2024).	+
	Energy efficiency disclosure (EED)	Energy efficiency disclosure index using researcher's compiled checklist.	Gianni et al., (2023) and Bagci et al. (2025)	+
	Renewable energy consumption disclosure (RECD)	Renewable energy consumption disclosure index using researcher's compiled checklist	Gianni et al., (2023) and Bagci et al. (2025)	+
	Carbon footprint disclosure (CFD)	Carbon footprint disclosure index using researcher's compiled checklist	Gianni et al., (2023). Kilian, (2025)	+
	Emissions trend disclosure (ETD)	Emissions trend disclosure index using researcher's compiled checklist	Zhou and Pan, (2022). Grahn(2024).	+
Financial performance *(Dependent variable)*	Gross profit margin (GPM)	Gross profit ÷ Revenue × 100%	Zhou and Pan, (2022). Okike et al., (2024).	

Source: Researcher's compilation (2025)

4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

This section focused on the presentation of data, analysis of the data, testing of the research hypotheses alongside the discussion of findings based on the results.

Data presentation

The data for this study is presented in table 4.1 in Appendix Ia. The data comprise a panel data of seventy (70) pooled observations across seven (7) listed pharmaceutical firms in Nigeria for ten (10) year period (2015-2024). The data include the dependent variable Gross profit margin and the independent variables which were emission intensity disclosure, energy

efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure of listed pharmaceutical firms in Nigeria.

Data analysis

Various statistical techniques were utilized in the analysis of the data presented in table 4.1 (see Appendix II). These include descriptive statistics, regression assumption tests and panel multiple regression analysis. The results from the panel multiple regression analysis were used in the testing of the research hypotheses which had been stated in the first section of this work.

Descriptive statistics

This was conducted to understand the behaviour of the data using various statistics including mean, standard deviation, skewness, and kurtosis. The result for the descriptive statistics analysis is as presented in table 4.2 below;

Table 4.2 Descriptive statistics results

	GPM	EID	EED	RECD	CFD	ETD
Mean	4.896695	54.04762	44.28571	60.00000	43.33333	35.95238
Median	2.730556	50.00000	50.00000	66.66667	41.66667	33.33333
Maximum	27.67136	83.33333	83.33333	83.33333	83.33333	66.66667
Minimum	0.132206	16.66667	16.66667	33.33333	16.66667	16.66667
Std. Dev.	5.952236	17.12785	15.76950	15.38554	17.11945	14.91676
Skewness	1.924692	-0.256818	0.523160	-0.017814	0.374991	0.176567
Kurtosis	6.321000	2.656424	3.432356	2.150632	2.653001	2.092423
Jarque-Bera	75.38652	1.113777	3.738338	2.107863	1.991740	2.766165
Probability	0.000000	0.572989	0.154252	0.348565	0.369402	0.250804
Sum	342.7687	3783.333	3100.000	4200.000	3033.333	2516.667
Sum Sq. Dev.	2444.609	20242.06	17158.73	16333.33	20222.22	15353.17
Observations	70	70	70	70	70	70

Source: Researcher's computation (2025) using E-views 10.0

The results in table 4.2 above indicates that the dependent variable-Gross profit margin and the independent variables which were emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure of listed pharmaceutical firms in Nigeria have mean scores of approximately 4.89%, 54.04%, 44.285%, 60%, 43.33% and 35.95%respectively. This indicates the central or average values for these variables from 2015 to 2024. The median values obtained for Gross profit margin, emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure of listed pharmaceutical firms in Nigeria were approximately 2.73%, 50%, 50%, 66.67%, 41.67% and 33.33%respectively. These constitute the middle values for the distributions of these variables under the period covered in this study (2015-2024).

In terms of the level of variability and dispersion in the distribution of these variables, the standard deviations obtained for Gross profit margin, emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure of listed pharmaceutical firms in Nigeria were approximately5.95, 17.12, 15.76, 15.38, 17.11 and 14.91respectively. This indicates varying levels of variability in the distribution with emission intensity disclosure indicating high variations in the distributions. Similarly, the skewness values obtained for Gross profit

margin, emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure of listed pharmaceutical firms in Nigeria were 1.924, -0.256, 0.523, -0.017, 0.374 and 0.176respectively. This quantifies the asymmetry of the distributions. In addition, the Kurtosis values obtained for these variables were given as approximately 6, 3, 3, 2,3, 2 respectively. Since the values of the kurtosis are greater than zero (0), it indicates a leptokurtic distribution, hence the presence of outliers in the data.

Model evaluation

Residual and coefficient diagnostics were however conducted to assess the suitability of the model as stated in the previous section. These include normality test, multi collinearity test, heteroscedasticity test and autocorrelation assessment.

Normality test

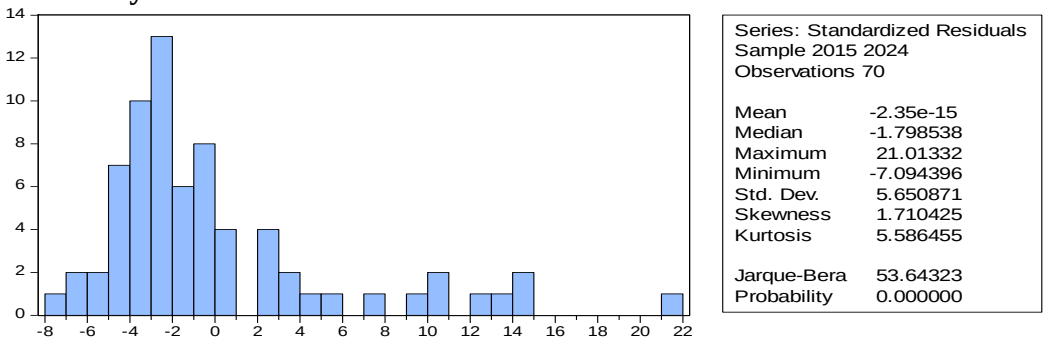

Fig. 4.1 Jarque-Bera Normality test results
Source: E-views 10.0 (2025)

The essence of a normality test is to determine if a dataset or sample follows a normal distribution. This is important because many statistical models assume normality, and deviations from normality can affect the validity of statistical inference. The Jarque-Bera test was employed in this case. As applied, if the p-value associated with the Jarque-Bera test is below a predetermined significance level ($p<0.05$), then we reject the null hypothesis and conclude that the data do not follow a normal distribution. With a p-value of 0.0000, there is sufficient evidence to conclude that the data were not normally distributed.

Multicollinearity test

	GPM	EID	EED	RECD	CFD	ETD
GPM	1.000000	-0.127199	0.126293	0.166754	0.205327	0.235474
EID	-0.127199	1.000000	0.338657	0.167572	-0.073651	-0.243070
EED	0.126293	0.338657	1.000000	0.578577	0.177714	0.058859
RECD	0.166754	0.167572	0.578577	1.000000	0.150034	0.252086
CFD	0.205327	-0.073651	0.177714	0.150034	1.000000	-0.010308
ETD	0.235474	-0.243070	0.058859	0.252086	-0.010308	1.000000

Source: Researcher's computation (2025) using E-views 10.0

The correlation analysis showed that all independent variables- emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosurecoefficients lesser than 0.80 respectively confirming absence of multicollinearity issues.

Heteroscedasticity test

Table 4.4 Heteroscedasticity test

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	22.09221	21	0.3942
Pesaran scaled LM	-0.911592		0.3620
Pesaran CD	-0.931588		0.3515

Source: Researcher's computation (2025) using E-views 10.0

Heteroscedasticity refers to the unequal spread of residuals (or errors) across the range of predictor variables in a regression model. Heteroscedasticity tests aim to detect this violation of the assumption of constant variance. Common tests include the Breusch-Pagan test and the White test, which assess the relationship between the squared residuals and the predictor variables. The statistics and probability value associated with the Breusch-Pagan LM test otherwise known as the Breusch-Pagan Godfrey test help determine whether there is evidence of heteroscedasticity in the regression model. A low p-value ($p<0.05$) suggests evidence against the null hypothesis in favour of the alternate hypothesis which indicates the presence of heteroscedasticity in the regression model. With a p-value of 0.3942, there is sufficient evidence to accept the null hypothesis, thus, conclude that the predictor variables in the regression model were homoscedastic.

Autocorrelation

Autocorrelation, also known as serial correlation, occurs when there is a correlation between the residual errors of a time series or panel data over time. Autocorrelation tests examine whether the residuals are independently distributed or if there is a systematic pattern of dependence. The Durbin-Watson statistic is commonly used to test for autocorrelation, with values close to 2 indicating no significant autocorrelation. The Durbin-Watson statistic as obtained from the panel regression results (see Appendix II) was utilized in this case. The Durbin-Watson statistic value of 1.2337 suggests that there is a low negative autocorrelation present in the data.

Test of hypotheses

Each of the hypotheses in this study was tested based on the result obtained from the panel multiple regression analysis. The result that relate to these hypotheses is summarized in table 4.5 below;

Table 4.5 Panel multiple regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.600757	4.080883	4.147212	0.0000
EID	-0.000619	0.044061	-4.014041	0.0088
EED	0.052289	0.058895	0.887832	0.3780
RECD	-0.069355	0.059240	-3.170760	0.0460
CFD	0.071690	0.044165	1.623249	0.1095
ETD	0.085349	0.051117	3.669673	0.0099
R-squared	0.098698	Mean dependent var		4.896695
Adjusted R-squared	0.028284	S.D. dependent var		5.952236

S.E. of regression	5.867457	Akaike info criterion	6.458536
Sum squared resid	2203.331	Schwarz criterion	6.651264
Log likelihood	-220.0488	Hannan-Quinn criter.	6.535090
F-statistic	12.01675	Durbin-Watson stat	1.233706
Prob(F-statistic)	0.000655		

Source: Researcher's computation (2025) using E-views 10.0

The multiple regression line is as written below:
GPM = 0.600756822021 - 0.000618659610205*EID + 0.0522885785173*EED - 0.0693552746798*RECD + 0.0716900708165*CFD + 0.0853485965904*ETD+ μ

The regression line suggests that a 1-unit increase in Emission Intensity Disclosure (EID) is associated with a 0.062% decrease in Gross Profit Margin (GPM), while a 1-unit increase in Energy Efficiency Disclosure (EED) is associated with a 5.23% increase in GPM. Additionally, a 1-unit increase in Renewable Energy Consumption Disclosure (RECD) is associated with a 6.94% decrease in GPM, whereas a 1-unit increase in Carbon Footprint Disclosure (CFD) is associated with a 7.17% increase in GPM, and a 1-unit increase in Emissions Trend Disclosure (ETD) is associated with an 8.53% increase in GPM.

Hypothesis one

H_0: There is no significant relationship between emission intensity disclosure and financial performance of listed pharmaceutical firms in Nigeria.

H_1: There is significant relationship between emission intensity disclosure and financial performance of listed pharmaceutical firms in Nigeria.

In order to test whether the variations in gross profit margin of listed pharmaceutical firms in Nigeria caused by emission intensity disclosure is significant. The T-test was carried out at .05 significance level with Ttab of 2.3646 given at $_{T0.05,7}$. From the result above, the Tcal of 4.0140 is greater than Ttab given at $_{T0.05,7}$. Hence, the null hypothesis which states that there is no significant relationship between emission intensity disclosure and financial performance of listed pharmaceutical firms in Nigeria fails to hold, thus rejected, and the alternative hypothesis accepted. The null hypothesis is further rejected given that at $_{T0.05,7}$, its probability value (p= 0.0088) is less than 0.05.

Hypothesis two

H_0: Energy efficiency disclosure has no significant relationship with financial performance of listed pharmaceutical firms in Nigeria.

H_1: Energy efficiency disclosure has significant relationship with financial performance of listed pharmaceutical firms in Nigeria.

Since Tcal (0.887832) is less than Ttab (2.3646) and the p-value (0.3780) is greater than 0.05, we fail to reject the null hypothesis. Therefore, there is no significant relationship between energy efficiency disclosure and financial performance of listed pharmaceutical firms in Nigeria.

Hypothesis three

H_0: No significant relationship exists between renewable energy consumption disclosure and financial performance of listed pharmaceutical firms in Nigeria.

H_1: Significant relationship exists between renewable energy consumption disclosure and financial performance of listed pharmaceutical firms in Nigeria.

Since Tcal (-3.170760) is greater than Ttab (2.3646) in absolute terms and the p-value (0.0460) is less than 0.05, we reject the null hypothesis. Therefore, there is a significant relationship between renewable energy consumption disclosure and financial performance of listed pharmaceutical firms in Nigeria.

Hypothesis four

H_0: Carbon footprint disclosure has no significant relationship with financial performance of listed pharmaceutical firms in Nigeria.

H_1: Carbon footprint disclosure has significant relationship with financial performance of listed pharmaceutical firms in Nigeria.

Since Tcal (1.623249) is less than Ttab (2.3646) and the p-value (0.1095) is greater than 0.05, we fail to reject the null hypothesis. Therefore, there is no significant relationship between carbon footprint disclosure and financial performance of listed pharmaceutical firms in Nigeria.

Hypothesis Five

H_0: There is no significant relationship between emissions trend disclosure and financial performance of listed pharmaceutical firms in Nigeria.

H_1: There is significant relationship between emissions trend disclosure and financial performance of listed pharmaceutical firms in Nigeria.

Since Tcal (3.669673) is greater than Ttab (2.3646) and the p-value (0.0099) is less than 0.05, we reject the null hypothesis. Therefore, there is a significant relationship between emissions trend disclosure and financial performance of listed pharmaceutical firms in Nigeria.

DISCUSSION OF FINDINGS

Emission intensity disclosure and financial performance

The study found a significant negative relationship between emission intensity disclosure and financial performance of listed pharmaceutical firms in Nigeria. This finding suggests that firms with higher emission intensity disclosure tend to have lower financial performance. This result is consistent with the studies by Hewagama et al. (2025), which found that carbon emissions are significantly and negatively associated with firm performance in New Zealand, and Mamatzakis and Tzouvanas (2025), which found that greenhouse gas emissions increase earnings management, leading to lower quality financial reporting. The negative relationship between emission intensity disclosure and financial performance may be due to the fact that firms with high emission intensity may be perceived as being less environmentally responsible, which can lead to a negative impact on their financial performance. Other studies that support this finding include Luu et al. (2025), who found that firms with high greenhouse gas emissions tend to engage in greenwashing behavior, which can negatively impact their financial performance.

Energy Efficiency disclosure and financial performance

The study found no significant relationship between energy efficiency disclosure and financial performance of listed pharmaceutical firms in Nigeria. This finding is consistent with the studies by Prasetyaningsih et al. (2025), which found that green accounting and carbon emission disclosure have no influence on firm value in the energy sector in Indonesia, and Matthews et al. (2024), who found that the relationship between greenhouse gas emissions and market value is complex and depends on various factors. The lack of significance may be due to the fact that energy efficiency disclosure is not a key driver of

financial performance in the pharmaceutical industry, or that the disclosure is not being perceived as value-relevant by investors. Other studies that support this finding include Kilian (2025), who found that the relationship between greenhouse gas emissions and financial performance is influenced by various factors, including the regulatory environment and industry characteristics.

Renewable energy consumption disclosure and financial performance

The study found a significant negative relationship between renewable energy consumption disclosure and financial performance of listed pharmaceutical firms in Nigeria. This finding is surprising, as one would expect that renewable energy consumption would have a positive impact on financial performance. However, this result may be due to the fact that renewable energy consumption is still a relatively new and emerging trend in the pharmaceutical industry, and firms may be incurring high costs in adopting renewable energy sources, which can negatively impact their financial performance. Other studies that support this finding include Bagci et al. (2025), who found that the impact of renewable energy consumption on greenhouse gas emissions varies across countries and industries.

Carbon footprint disclosure and financial performance

The study found no significant relationship between carbon footprint disclosure and financial performance of listed pharmaceutical firms in Nigeria. This finding is consistent with the studies by Prasetyaningsih et al. (2025), which found that carbon emission disclosure has no influence on firm value in the energy sector in Indonesia, and Matthews et al. (2024), who found that the relationship between greenhouse gas emissions and market value is complex and depends on various factors. The lack of significance may be due to the fact that carbon footprint disclosure is not a key driver of financial performance in the pharmaceutical industry, or that the disclosure is not being perceived as value-relevant by investors. Other studies that support this finding include Kilian (2025), who found that the relationship between greenhouse gas emissions and financial performance is influenced by various factors, including the regulatory environment and industry characteristics.

Emissions trend disclosure and financial performance

The study found a significant positive relationship between emissions trend disclosure and financial performance of listed pharmaceutical firms in Nigeria. This finding suggests that firms that disclose their emissions trends tend to have better financial performance. This result is consistent with the studies by Citraningtyas et al. (2025), which found that greenhouse gas emissions reporting is likely to increase firm value in the mining industry in Indonesia, and Abdalla et al. (2025), who found that firms with effective audit committees and internal audit teams tend to report more greenhouse gas emissions information. The positive relationship between emissions trend disclosure and financial performance may be due to the fact that firms that disclose their emissions trends are perceived as being more transparent and environmentally responsible, which can lead to a positive impact on their financial performance. Other studies that support this finding include Zhang et al. (2025), who found that firms with greater gender diversity in the boardroom experience a stronger risk-reducing effect from greenhouse gas disclosure.

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

This section summarizes the research findings, offer recommendations and suggestions for further studies. It also discusses this present study's key contributions to knowledge.

Summary of findings

This study examined the relationship between greenhouse gas emission disclosures and financial performance of pharmaceutical firms listed on the floor of the Nigerian Exchange Group (NGX) over a period of ten years (2015-2024). The independent variable (greenhouse gas emission disclosures) was proxied by emission intensity disclosure, energy efficiency disclosure, renewable energy consumption disclosure, carbon footprint disclosure and emissions trend disclosure. Furthermore, the dependent variable (financial performance) was proxied by gross profit margin (GPM). Below is a summary of findings gathered through a panel multiple regression analysis.

1. Emission intensity disclosure has a significant negative relationship (Coeff. = -0.000619, p-value = 0.0088) with financial performance of listed pharmaceutical firms in Nigeria.
2. Energy efficiency disclosure has no significant relationship (p-value = 0.3780) with financial performance of listed pharmaceutical firms in Nigeria.
3. Renewable energy consumption disclosure has a significant negative relationship (Coeff. = -0.069355, p-value = 0.0460) with financial performance of listed pharmaceutical firms in Nigeria.
4. Carbon footprint disclosure has no significant relationship (p-value = 0.1095) with financial performance of listed pharmaceutical firms in Nigeria.
5. Emissions trend disclosure has a significant positive relationship (Coeff. = 0.085349, p-value = 0.0099) with financial performance of listed pharmaceutical firms in Nigeria.

Conclusion

In conclusion, greenhouse gas emission disclosures have a significant relationship with financial performance of pharmaceutical firms listed on the Nigerian Exchange Group (NGX). The findings suggest that emission intensity disclosure and renewable energy consumption disclosure have significant negative relationships with financial performance, while energy efficiency disclosure and carbon footprint disclosure have no significant relationships. These results imply that firms with high emission intensity and renewable energy consumption tend to have lower financial performance, which may be due to the costs associated with reducing emissions and adopting renewable energy sources. The study's findings have important implications for firms, investors, and regulators. For firms, the results suggest that reducing emission intensity and adopting renewable energy sources may be costly in the short term, but may lead to long-term benefits such as improved reputation and compliance with environmental regulations.

Recommendations

Based on the study findings, the following recommendations should be followed;

1. Pharmaceutical firms in Nigeria should prioritize reducing their emission intensity, as high emission intensity is negatively associated with financial performance. This can be achieved by implementing energy-efficient practices, investing in cleaner production technologies, and adopting sustainable supply chain practices.
2. Since energy efficiency disclosure has no significant relationship with financial performance, pharmaceutical firms in Nigeria may consider focusing on other sustainability initiatives that can drive financial performance, such as reducing waste, improving product packaging, or investing in renewable energy sources.
3. The negative relationship between renewable energy consumption disclosure and financial performance suggests that pharmaceutical firms in Nigeria may need to re-

evaluate their renewable energy strategies. This could involve assessing the costs and benefits of renewable energy adoption, exploring more cost-effective options, or seeking government incentives to support renewable energy investments.

4. Although carbon footprint disclosure has no significant relationship with financial performance, pharmaceutical firms in Nigeria should still prioritize transparency and accuracy in their carbon footprint reporting. This can help build trust with stakeholders, improve reputation, and ensure compliance with regulatory requirements.
5. Given the positive relationship between emissions trend disclosure and financial performance, pharmaceutical firms in Nigeria should prioritize transparent and regular reporting of their emissions trends. This can help investors and other stakeholders understand the firm's commitment to sustainability and environmental responsibility, which can positively impact financial performance.

Contributions to knowledge

1. This study provides empirical evidence on the relationship between greenhouse gas emission disclosures and financial performance of pharmaceutical firms in Nigeria, contributing to the growing body of literature on environmental sustainability and financial performance.
2. The study's focus on the pharmaceutical industry provides industry-specific insights that can inform decision-making and policy development in this sector.
3. The study's use of multiple proxies for greenhouse gas emission disclosures (emission intensity, energy efficiency, renewable energy consumption, carbon footprint, and emissions trend) provides a more comprehensive understanding of the relationship between GHG emissions and financial performance.
4. The study's focus on Nigeria provides valuable insights into the relationship between GHG emissions and financial performance in a developing country context, contributing to the limited literature on environmental sustainability in Africa.
5. The study's findings have practical implications for firms and policymakers, highlighting the need for sustainable practices and environmental responsibility in the pharmaceutical industry.

Suggestions for further studies

Other researchers are recommended to;

1. Examine the relationship between GHG emissions and financial performance in other industries, such as manufacturing or services, to provide a more comprehensive understanding of the relationship between environmental sustainability and financial performance.
2. Investigate the impact of GHG emissions on firm value, using market-based measures such as stock prices or market capitalization.
3. Explore the role of institutional factors, such as regulatory frameworks or stakeholder pressure, in shaping the relationship between GHG emissions and financial performance.
4. Use alternative measures of financial performance, such as return on assets (ROA) or return on equity (ROE), to provide a more comprehensive understanding of the relationship between GHG emissions and financial performance.
5. conduct a comparative study across countries to examine the relationship between GHG emissions and financial performance in different regulatory and institutional contexts.

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