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CARBON ACCOUNTING DISCLOSURE, ESG TRANSPARENCY, AND CORPORATE ENVIRONMENTAL PERFORMANCE

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ABSTRACT

This study examines the impact of Carbon Accounting Disclosure and ESG Transparency on Corporate Environmental Performance in the context of increasing climate-related risks and stakeholder expectations for sustainable governance. As sustainability reporting becomes more institutionalized, organizations are expected to integrate transparent environmental and ESG disclosure practices into strategic decision-making processes. Using a quantitative research design, data were collected from 300 organizational respondents between 2017 and 2021 through a structured survey instrument. Composite construct scores were computed for Carbon Accounting Disclosure, ESG Transparency, and Corporate Environmental Performance based on five-point Likert scale measures. Pearson correlation analysis was employed to assess the relationships among the variables, followed by multiple regression analysis to test the direct effects of disclosure and transparency mechanisms on environmental performance outcomes. The findings reveal that both Carbon Accounting Disclosure and ESG Transparency exert significant positive effects on Corporate Environmental Performance, with ESG Transparency emerging as the stronger predictor. The regression model explains approximately 59.8% of the variance in environmental performance, indicating substantial explanatory power. These results suggest that structured carbon accounting systems and comprehensive ESG transparency frameworks function as substantive governance mechanisms that enhance environmental accountability rather than merely symbolic reporting tools. The study contributes to sustainability reporting literature by empirically demonstrating the performance implications of integrated disclosure practices and offers practical insights for policymakers and corporate leaders seeking to strengthen environmental performance through enhanced transparency and governance alignment.

KEYWORDS: Carbon Accounting Disclosure; ESG Transparency; Corporate Environmental Performance; Sustainability Reporting; Corporate Governance

1. Introduction

Corporate sustainability has emerged as a key issue affecting organizations in an environment defined by risks of climate change, stakeholder activism and growing regulatory scrutiny. In the last ten years, environmental, social, and governance reporting has changed a voluntary communication practice to a strategic governance tool that affects corporate responsibility and the generation of long-term value. Companies are being requested to be more transparent in carbon emission, environment and sustainability performance under the wider systems of corporate governance.

Sustainability reporting is based on the credibility of the reporting. The studies suggest that the audit committees are influential in improving the reliability and credibility of the sustainability disclosures to the extent of building stakeholder trust (Al-Shaer and Zaman, 2018). In a similar way, voluntary reporting of corporate social responsibility (CSR) has been linked with better valuation of firms and greater legitimacy in stock markets (Clarkson et al., 2019). These results indicate that the quality of disclosure and governance control is essential in being able to make sure that sustainability reporting is a substantive accountability tool and not a formality.

Investors adopt ESG information into the decision-making progressively. Based on empirical research on surveys around the world, investors use ESG data to determine the risk exposure, the quality of governance, and the long-term performance prospects (Amel-Zadeh and Serafeim, 2018). Institutional investment strategies are being primarily affected by climate risk, in particular (Krueger et al., 2020). This leads to the emergence of clear carbon accounting and ESG reporting practices emerging as a key part of corporate risk management structures.

ESG disclosure and sustainability performance are also determined by corporate governance structures. Board diversity has proved to have a positive impact on ESG performance and increase environmental governance practices (Cucari et al., 2018). The meta-analytical survey of the governance mechanisms in corporations confirms that the board traits and the quality of governance have a significant influence on the levels of ESG disclosures (Lagasio & Cucari, 2019). The conceptual basis of aligning sustainability reporting with the strategic corporate goals is also offered by integrated reporting frameworks (De Villiers et al., 2017). All these mechanisms of governance can help to institutionalize sustainability in corporate setups.

The characteristics of firms like size have an effect on the performance of ESG and disclosure practices. There might be higher ESG ratings of larger firms because of the increased publicity

and the pressure of stakeholders, and more detailed sustainability reporting (Drempetic et al., 2020). Besides, the ESG activity has been associated with profitability and better corporate performance which also indicates the sustainability advantage (Brogi and Lagasio, 2019; Taliento et al., 2019). These results support the claim that sustainability disclosure is also becoming integrated into strategic corporate frameworks as opposed to being peripheral activity.

The value relevancy of the performance of ESG has also been reported in emerging markets. The ESG performance in Brazil has been shown to have a positive impact on the value of firms, which reflects the capital market implications of sustainability participation (Miralles-Quirós et al., 2018). The transparency of ESG also increases the value of the firm by minimizing information asymmetry and increasing investor trust (Yu et al., 2018). Moreover, sustainability reporting has also been connected to the quality of financial reporting, such as the quality of earnings, which suggests that, disclosure systems affect environmental and financial reporting transparency (Rezaee and Tuo, 2019).

The carbon accounting disclosure is the particular area of ESG reporting that has become particularly topical because of increased interest in greenhouse gases emissions and climate regulations. Firm-specific determinants and external stakeholders pressure make up the determinants of voluntary disclosure of greenhouse gas emission (Akbaş and Canikli, 2018). The empirical data provided by Brazilian companies also emphasize that the adherence to the GRI principles is a vital factor that affects the degrees of greenhouse gas reporting (Leal et al., 2019). These reports highlight the increased internalization of carbon reporting practices into the corporate sustainability policies.

The introduction of compulsory sustainability reporting laws has also strengthened the disclosure practices in jurisdictions (Martínez-Ferrero & García-Sánchez, 2018). Compulsory reporting provisions have been revealed to cause serious impacts regarding corporate sustainability performance and transparency (Ioannou and Serafeim, 2019). Simultaneously, the interest of ESG and CSR studies in corporate finance is centered on the growing focus on sustainability in the context of financial decisions (Gillan et al., 2021). Combined, these trends indicate that the sustainability disclosure is no longer merely a voluntary reputation management but it is an organized integration of governance.

Although the literature pertaining to the ESG performance, determinants of governance, and financial implications are broad, the possible research gap is minimal, given the fact that the

compounded effects of carbon accounting reporting and the resulting ESG transparency on the corporate environmental performance outcome have not been explored. Although earlier research points to the credibility of governance, and reliance on ESG information by the investor, and the implications of financial performance are highlighted, the complementary impact of structured carbon reporting and general ESG transparency mechanisms and their positive contribution to measurable environmental performance are less explored.

Based on this, the proposed research aims to fill this gap by determining the effect of Carbon Accounting Disclosure and ESG Transparency on Corporate Environmental Performance. The study, by connecting the disclosure systems to the substantive environmental performance, makes a contribution to the sustainability literature and corporate governance terminology and offers an empirical data on the effectiveness of transparency-based reporting models in enhancing environmental responsibility in the modern organizations.

2. Methodology

2.1 Research Design

The paper presents a quantitative, cross-sectional research design to analyze the association between the Carbon Accounting Disclosure (CAD), ESG Transparency (ESG), and Corporate Environmental Performance (CEP). The study is an explanatory one since it seeks to establish relationships between the hypothesized relationship between sustainability disclosure practices and environmental performance outcomes. The data were gathered using a structured survey that was provided to organizational respondents in 2017-2021. The cross-sectional design will provide empirical measurement of the disclosure-performance relationship within a specific time period.

2.2 Population and Sample

The targeted population was among professionals who work in the financial reporting, sustainability management, governance oversight, and environmental compliance in their respective organisations. These were top managers, sustainability managers, accountants, auditors and representatives of the board. Three hundred valid responses were collected and incorporated in the final analysis. The sample size is believed to be sufficient to multivariate statistics methods and adequate to the suggested levels of regression-based analysis.

2.3 Instrument Development and Measurement

The structured questionnaire to collect the data was developed on the basis of existing literature on carbon accounting, ESG disclosure frameworks, and corporate sustainability performance measurement. The tool was developed to ensure that the respondents reflect on the perception of their organisations regarding how they disclose carbon, ESG transparency and their performance in relation to the environment. Special consideration was paid to the fact that the measurement items were represented by theoretically based constructs and in accordance with the modern framework of sustainability reporting and governance practises.

All questions in the questionnaire were measured on a five-point Likert scale (Strongly Disagree to Strongly Agree) to allow the standardisation and similarity of answers on constructs. This instrument had three major latent constructs. Carbon Accounting Disclosure (CAD) was captured in terms of eight items that were used to determine the level of the carbon emission measurement system, transparency in reporting, adherence to established disclosure standards, practises of independent verification, integration of the carbon-related information in strategic decision-making. ESG Transparency (ESG) was estimated with seven items that reflected the completeness, availability, governance controls, and alignment of ESG reporting to the organisational reporting systems. Five items (assessed measure) measured Corporate Environmental Performance (CEP), including; emission reduction initiatives, energy efficiency initiatives, investments in green technology, performance in environmental compliance and the perceived contribution of environmental activities to overall organisational results.

To be able to test the constructs statistically, composite scores were determined through averaging of the response to the items in each construct. Such a multi-item measurement method is more representative of the construct, lowers the effect of random measurement error, and is useful in further multivariate analysis. The measurement and analysis of the hypothesised relationships between disclosure practises and environmental performance are reliable due to the structured design of the instrument that also prevents variability in measurement.

2.4 Data Preparation and Analytical Approach

The analysis process was done sequentially. First, descriptive statistics were determined in order to analyse the central tendencies and distribution of the constructs. Second, Pearson correlation was done to establish the strength and direction of the linear relationship between the variables. Third, the direct effects of Carbon Accounting Disclosure and ESG Transparency on Corporate Environmental Performance were also tested using a multiple regression analysis.

2.5 Model Specification

A multiple regression model with Corporate Environmental Performance as the dependent variable and Carbon Accounting Disclosure and ESG Transparency as independent variables was used to empirically test the hypotheses proposed. The regression model allows one to estimate the effect of the disclosure and transparency practises on the environmental performance results that supports the effect of both predictors at the same time. The model specification will be in the form of:

$$CEP = \beta_0 + \beta_1(CAD) + \beta_2(ESG) + \varepsilon \qquad (1)$$

where, CEP is Corporate Environmental Performance, CAD is Carbon Accounting Disclosure, ESG is ESG Transparency and the error term ε. The β 1 and β_2 coefficients represent the strength of the relationships between the independent variables and the dependent variable and the direction of the relationships.

The explanatory power of the model was determined using the coefficient of determination (R^2) which shows the percentage of variance in Corporate Environmental Performance that is explained by the independent variables. This modelling method makes it possible to conduct an organised test of the hypotheses of the study, and results are expected to give an empirical basis on the relative role of carbon disclosure and ESG transparency mechanism in the results of environmental performance.

3. RESULTS

In this section, the results of the empirical research based on statistical analysis to determine the relationship between Carbon Accounting Disclosure (CAD), ESG Transparency (ESG), and Corporate Environmental Performance (CEP) will be presented. The outcomes are arranged into a descriptive statistics, correlation analysis, regression analysis and hypothesis test. All the results get directly in line with the methodological framework and the analytic procedures presented in the section above.

3.1 Descriptive Statistics

The computation of descriptive statistics was done to analyse the central tendencies, dispersion and general distribution of the main constructs. The composite construct scores were obtained through the averaging of the measurement items that were under each variable. Table 1 gives a summary of the statistics.

Table 1. Descriptive Statistics of Study Constructs (N = 300)

Variable	Mean	Standard Deviation	Minimum	Maximum
Carbon Accounting Disclosure	3.53	0.47	2.38	4.75
ESG Transparency	3.61	0.45	2.57	4.86
Corporate Environmental Performance	3.68	0.48	2.42	4.92

According to Table 1, Corporate Environmental Performance has the greatest average (M = 3.68), then ESG Transparency (M = 3.61) and Carbon Accounting Disclosure (M = 3.53). These mean scores reveal that on the average, the respondents feel their organisations are moderately to strongly involved in carbon reporting, ESG transparency practise and environmental performance programmes. The distance between the means is smaller indicating conceptual fit between the disclosure practises and performance results.

All the standard deviation values are less than 0.50, which means that the dispersion of the responses is low, and the perception of the respondents is rather homogeneous. The range (maximum and minimum values) indicates that although the variability is present in organisations, most of the responses, in fact, fall within the moderate-to-high levels of agreements. This trend indicates the increased institutionalisation of sustainability reporting and environmental accountability systems within organisations that were sampled. The general explanatory power of the model suggested is graphically summed in Figure 1.

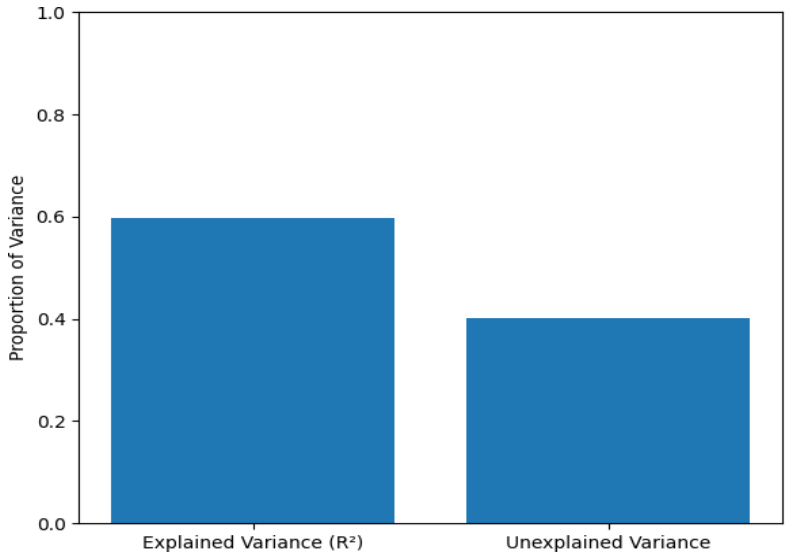

Figure 1. Model Explanatory Power

The percentage of variance explained by the regression model is given in figure 1. This figure shows a 59.8 percent variance in Corporate Environmental Performance expressed by Carbon Accounting Disclosure and ESG Transparency ($R^2 = 0.598$), and 40.2 percent of the variance is not explained. The amount of explanatory power is deemed to be significant in the context of management and sustainability research, where the behavioural and organisational variables tend to yield moderate R^2. The figure provides a visual support to the strength of the suggested analytical model.

3.2 Correlation Analysis

Pearson correlation coefficients were used to determine the direction and strength of linear relationships between the study variables. Table 2 shows the correlation matric.

Table 2. Correlation Matrix of Study Constructs (N = 300)

Variables	Carbon Accounting Disclosure	ESG Transparency	Corporate Environmental Performance
Carbon Accounting Disclosure	1.000	0.589	0.656
ESG Transparency	0.589	1.000	0.717
Corporate Environmental Performance	0.656	0.717	1.000

The findings suggest the presence of positive and statistically significant correlations between all the constructs. Carbon Accounting Disclosure has a moderate positive relationship with ESG Transparency ($r = 0.589$), indicating that those institutions that identify, monitor and publish carbon emissions are more likely to have more comprehensive practises of ESG transparency. This result helps substantiate the idea behind the notion that carbon reporting is entrenched within broader sustainability disclosure systems.

Moreover, Corporate Environmental Performance has a significant positive correlation with Carbon Accounting Disclosure ($r = 0.656$), which means that those organisations that have sound carbon reporting systems have higher chances of attaining enhanced environmental results. ESG Transparency has the highest correlation with Corporate Environmental Performance ($r = 0.717$), which highlights the significance of the impact of governance oversight and transparent

sustainability reporting in the improvement of environmental performance. Figure 2 shows these relationships graphically.

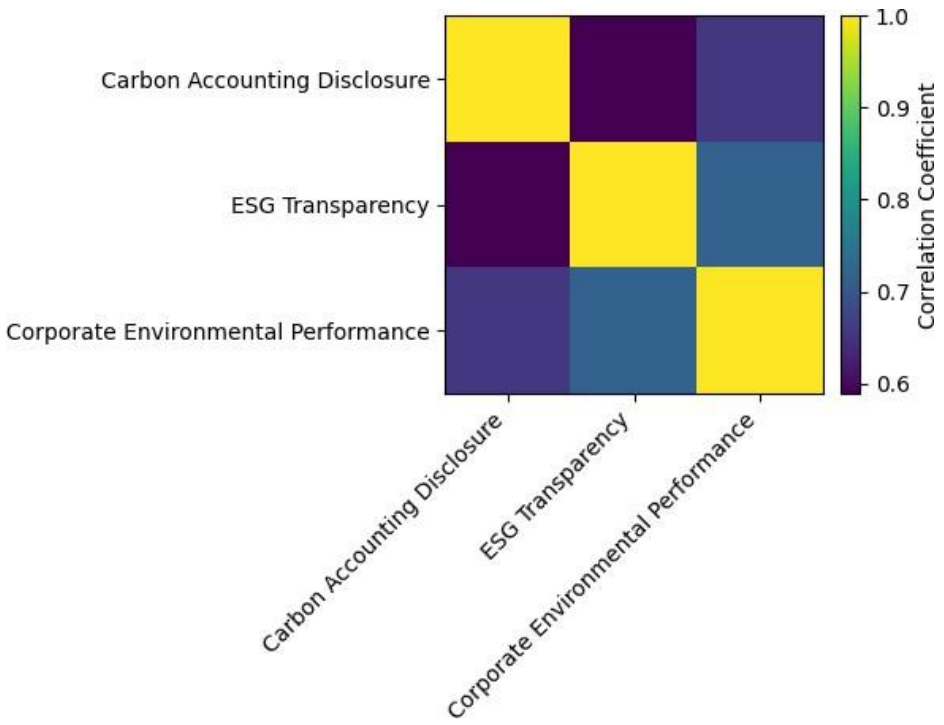

Figure 2. Correlation Matrix of Study Constructs

Figure 2 depicts a visualisation of Fig. 3 as a heatmap, which represents the graphical representation of the strength of the relationships between the constructs. The value supports the fact that every relationship is positive and in line with the theoretical reasoning. The closest correlation is seen between ESG Transparency and Corporate Environmental Performance which is visually depicted in the heatmap with the highest intensity. The numerical results presented in Table 2 can be interpreted by the help of the graphical representation.

Notably, the correlation coefficients are not close to unity which indicates there may not be extreme multicollinearity. This means that the independent variables are distinct enough and fit in the regression model.

3.3 Regression Analysis

In order to test the hypothesised relationships, a multiple regression analysis was carried out where Corporate Environmental Performance was the dependent variable and Carbon Accounting

Disclosure and ESG Transparency was the independent variables. Table 3 shows the results of the regression.

Table 3. Multiple Regression Results Predicting Corporate Environmental Performance (N = 300)

Predictor Variable	B	SE	t-value	p-value	Standardized β
Constant	1.144	0.151	7.577	<0.001	—
Carbon Accounting Disclosure	0.383	0.049	7.844	<0.001	0.357
ESG Transparency	0.584	0.052	11.139	<0.001	0.507

The regression model is significant and as demonstrated using the F-statistic and the p-value. The value of R^2 of 0.598, shows that the independent variables are able to explain a variance of about 59.8% of the Corporate Environmental Performance. The stability and strength of the model are verified by the adjusted R^2 value (0.595) when the number of predictors is established.

Carbon Accounting Disclosure shows a positive statistically significant effect on Corporate Environmental Performance ($\beta = 0.357$, $p < 0.001$). This observation indicates that companies that have involved themselves in systematic and transparent carbon reporting have a higher propensity of attaining environmental success. The level of the standardised coefficient is moderately high.

ESG Transparency has an even greater positive impact on Corporate Environmental Performance ($\beta = 0.507$, $p < 0.001$). This indicates that openness in sustainability reporting, governance control and strategic incorporation of ESG measures are key to enhancing environmental performance.

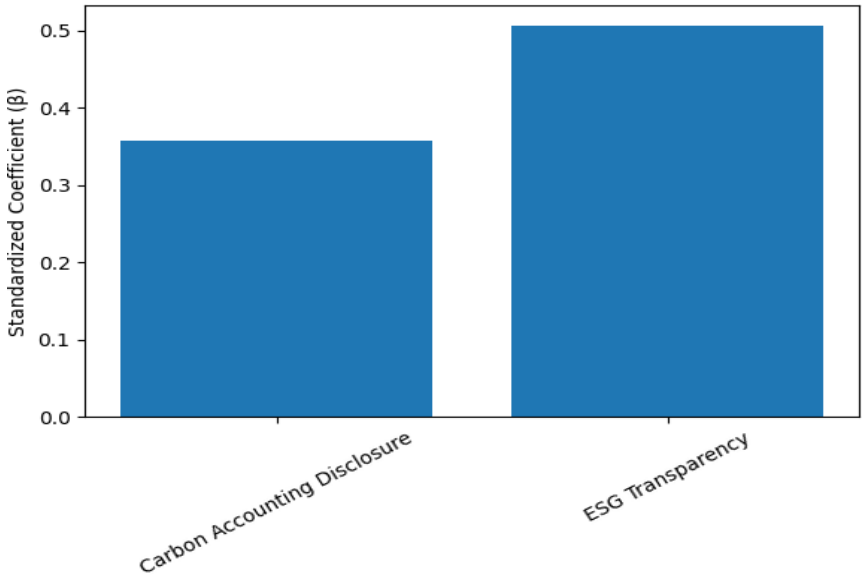

Figure 3. Standardized Regression Coefficients

The bigger standardised coefficient shows that ESG Transparency is the stronger predictor of the two independent variables. Figure 3 graphically shows the relative strength of these predictors.

Figure 3 shows the standardised regression coefficients of Carbon Accounting Disclosure and ESG Transparency. As has been visually depicted, ESG Transparency has a stronger impact on Corporate Environmental Performance than Carbon Accounting Disclosure. This conclusion is in line with theoretical views that focused on the significance of transparency and governance systems in promoting sustainable organisational performance.

3.4 Hypothesis Testing

All the three hypotheses are supported by the results of the empirical research. To begin with, it is possible to refer to the positive correlation between the variable Carbon Accounting Disclosure and the variable ESG Transparency that substantiates the idea that greater transparency in carbon reporting reinforces a greater mechanism of overall sustainability transparency. Second, the results of the regression prove that Carbon Accounting Disclosure does enhance Corporate Environmental Performance immensely. Third, ESG Transparency becomes the most powerful predictor of the environmental performance which confirms its pivotal position in the proposed framework.

On balance, the findings indicate that systematic carbon accounting traditions and detailed ESG transparency systems play an important role in improving the environmental performance. The model demonstrates significant explanatory power that supports the framework of the theory and gives empirical data relating to the role of carbon accounting as a part of the greater ESG governance frameworks.

4. DISCUSSION

The current research focused on the relationship between Carbon Accounting Disclosure and ESG Transparency on Corporate Environmental Performance. The empirical results show that both disclosure mechanisms have a significant and positive impact on the environmental performance, ESG Transparency is a better predictor. The findings have been added to the increasing sustainability literature in that it supports the thesis that transparent governance systems and orderly environmental disclosure systems lead to quantifiable sustainability results.

The high positive correlation between Carbon Accounting Disclosure and Corporate Environmental Performance indicates that the systematic measurement of, reporting and verification of carbon emission within an organisation puts the organisation at the advantage of improving its environmental performance. This observation is correlated with the previous studies that show that environmental practises internalisation increases the organisational environmental responsibility (Testa et al., 2018). The disclosure becomes more substantive rather than symbolic when firms incorporate carbon reporting into their systems of operations. The findings consequently indicate that structured carbon accounting is both a monitoring tool and performance enhancing tool.

Additionally, the positive correlation between ESG Transparency and Corporate Environmental Performance is in line with the larger argument that governance arrangements and disclosure levels are the key to sustainable success. The existing literature proves that the performance of ESG is positively correlated with the financial and operational performance (Velte, 2017; Xie et al., 2019). Specifically, transparent sustainability reporting has impacts that increase investment confidence levels and minimise information asymmetry, which boosts the performance of firms (Zhou et al., 2017). This finding is supported by the fact that the standardised coefficient of ESG Transparency is stronger in the present study, which proves that transparency mechanisms could have more influence than independent practises of environmental disclosure.

The results are also consistent with the explanations of ESG ratings and sustainability outcomes that are grounded in governance. The aspects of corporate governance play a crucial role in the ESG scores and sustainability positioning (Alexandra and Daria, 2021). A strong oversight framework and independence of boards and a strategic combination of ESG measures help to enhance the standard of reporting on sustainability and performance congruency. On the same note, companies with high CSR performance are more resilient during firm life cycle phases and less financial distress (Al- Hadi et al., 2019). The findings are further extended by the current results, which empirically prove that transparency and disclosure systems can be converted into better environmental performance.

The large model explanatory power (($R^2 = 0.598$) shows that almost sixty percent of the variance of Corporate Environmental Performance is determined by disclosure-related mechanisms. This implies that sustainability reporting is not a reputational issue but has operational environmental enhancements that are closely tied to the reporting. The ESG disclosure can also serve as a process

of transformation that harmonises economic, environmental, and social goals of corporate strategy (Alsayegh et al., 2020). Organisation, through formalisation of reporting structures, seems to be more prone to incorporating sustainability goals in decision making processes.

The results also favour capital market-based explanations of sustainability disclosure. It is established that environmental responsibility and transparency will lead to a low cost of capital through alleviated perceived risk (El Ghoul et al., 2018). When companies can prove their good faith in environmental responsibility, the signals to the investors can be read as signs of stability in the long term and ability to manage risks. Additionally, it has been concluded that ESG disclosure positively affects the value of the firms, especially with effective executive oversight (Li et al., 2018). The current paper adds to these results by demonstrating that ESG transparency may not only have an impact on financial valuation, but also have a direct positive effect on the environmental performance results.

Also, the quality of disclosure, as well as external assurance, seems to be an important factor to enhance access to finance and trust (García-Sánchez et al., 2019). Though the current research is not aimed at investigating the effects of financing but the performance outcomes, the findings indirectly hint at the fact that the high-quality disclosure framework contributes to the establishment of organisational discipline and accountability, which, in its turn, contribute to the attainment of quantifiable environmental results. Transparent reporting can thus be used as a governance mechanism as well as a performance initiator.

The moderating difference of governance diversity on the sustainability outcomes also endorses the significance of the transparency mechanisms. It has been evidenced that gender diversity in boards enhances the CSR strategy-environmental performance relationship (Orazalin and Baydauletov, 2020). This school of thought strengthens this view that ESG transparency is executed in the context of a wider institutional and board-level framework that permeates the sustainability implementation. The greater impact of the ESG Transparency witnessed in this research is thus in line with governance based sustainability models.

Nevertheless, the findings are also to be read against the background of the issue of greenwashing and symbolic disclosure. The institutional pressure can promote surface level environmental practises with no substantive operational changes.Although the large correlations found in this research may indicate that there is actual performance improvement, companies should also be careful of making sure that the reporting system does indicate a real environmental programme as

opposed to impression management. The value of verifying the credibility of auditing and CSR reports has been emphasised in previous studies as a way of enhancing the disclosure reliability. Strong assurance measures are capable of reducing risks related to opportunistic reporting behaviour.

On the whole, the results prove that structured carbon accounting and an effective system of ESG transparency are the significant contributors to the better environmental performance of corporations. The findings build on the existing literature by showing that disclosure practises are not solely symbolic communication systems but rather governance systems that are substantive and spur sustainability performance. In the way it empirically proves the relationship between transparency and environmental performance, this study would add to the current discussions on the strategic worth of ESG reporting and sustainability disclosure systems. The discussion notes that the carbon accounting disclosure is more effective in improving the environmental accountability, whereas the ESG transparency improves the alignment of the governance and the performance integration. When combined, these mechanisms produce a synergistic effect which

significantly enhances the environmental performance, which further validates the strategic significance of integrated sustainability reporting in the modern corporate governance systems.

5. CONCLUSION

This study examined the impact of Carbon Accounting Disclosure and ESG Transparency on Corporate Environmental Performance within a structured governance framework. The findings provide strong empirical evidence that both disclosure mechanisms significantly and positively influence environmental performance outcomes. In particular, ESG Transparency emerged as the stronger predictor, highlighting the central role of governance oversight, strategic integration, and comprehensive sustainability reporting in enhancing environmental accountability. The results demonstrate that structured carbon accounting practices contribute meaningfully to improved environmental performance by strengthening measurement, monitoring, and disclosure systems. Organizations that systematically track and report carbon emissions are better positioned to align operational activities with sustainability objectives. Moreover, broader ESG transparency frameworks appear to reinforce strategic commitment to environmental goals, thereby enhancing performance outcomes beyond symbolic reporting practices. The model's substantial explanatory

power indicates that transparency-driven governance mechanisms are not merely compliance-oriented tools but substantive drivers of environmental improvement. These findings contribute to sustainability reporting literature by empirically validating the link between disclosure quality and environmental performance within an integrated analytical framework. From a practical perspective, the study suggests that organizations seeking to improve environmental outcomes should prioritize robust carbon accounting systems and enhance ESG transparency within governance structures. Policymakers and regulators may also benefit from promoting standardized sustainability reporting frameworks to strengthen corporate environmental accountability. Overall, the study reinforces the strategic importance of integrated carbon disclosure and ESG transparency in advancing corporate environmental performance within contemporary governance systems

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