

Title: The Impact of Global Biodiversity Loss on Corporations across Industries

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Abstract

The decline in biodiversity poses a significant risk to the sustainability of industries and countries worldwide. Hence, businesses must understand and reduce their impact on biodiversity, and this commitment should be reflected in their annual and sustainability reports. This study draws on the natural capital-based view and examines data from 2,779 publicly traded companies in 59 countries from 2015 to 2023 to determine how companies address biodiversity issues and shape related disclosures. We find that some companies are taking biodiversity issues seriously. In addition, our findings show that green innovation has a direct and positive impact on financial performance indicators. This indicates that environment-friendly innovations make resource use more efficient and improves a company's reputation, subsequently enhancing its financial outcomes.

Keywords: Biodiversity, green innovation, sustainability, Corporates, Industries, Natural Capital-Based View

Word Count: 3450 words

Introduction

Although businesses and their boards are critical in addressing the challenges of global biodiversity loss, their approach to these challenges significantly differs (Hermelingmeier and von Wirth, 2021). Ambidextrous corporations are firms that can balance exploration and exploitation, leading to better corporate performance and competitiveness (Singh et al., 2022). Firms can enhance organisational initiatives and allocate resources to mitigate and prevent biodiversity loss while boosting their overall performance (Song et al., 2018). Innovative business strategies and environmental performance are essential for a healthy ecosystem and are vital in tackling major issues such as biodiversity loss. Efforts to reduce and halt biodiversity loss signify that corporate management and control strategies has shifted beyond traditional profit-focused models. Previous studies on business strategies and environmental issues primarily concentrate on business sustainability, corporate governance, sustainability reporting, green marketing, environmental management systems, innovation strategies, and environmental policies (Kumar et al., 2021). However, studies on biodiversity loss prevention are limited.

The role and composition of boards are vital for creating effective strategies to prevent biodiversity loss across all sectors of the global economy. Nonetheless, it remains uncertain how this worldwide systemic risk manifests as distinct material operational risks for companies across various sectors and subsequently results in indirect risks for lenders and investors who supply capital to the global economy. Although some industries, such as those in the extractives sector (UNEP-WCMC, 2017), have recognised the business risks associated with their adverse effects on biodiversity, the degree to which businesses in other sectors might be vulnerable to risks stemming from their reliance on biodiversity remains largely unexplored and

unresolved. This gap has put pressure on investors to become more aware of biodiversity risk (Gonçalves, 2021; Nauman, 2020).

Research on the link between board characteristics and environmental outcomes reveals that greater board independence and the inclusion of experts with specific skills (e.g. legal and environmental skills) are related to improved environmental performance. Resource dependence theory states that boards endowed with varied expertise, including legal and environmental acumen, offer essential resources and insights that improve environmental performance (De Villiers, Naiker, and Van Staden, 2011). The influence of board characteristics on global biodiversity loss is a critical area of study, particularly from the natural resource-based view (NRBV) of firms. The NRBV emphasises the strategic importance of natural resources and the role of corporate governance in managing these resources sustainably. As global biodiversity continues to decline, understanding how board characteristics influence a firm's impact on biodiversity is essential for developing effective corporate strategies and policies.

All firms contribute to biodiversity loss directly (e.g. tourism and mining sectors) or indirectly (e.g. retail and consumables sectors). Various industrial sectors substantially contribute to the decline of biodiversity through mechanisms such as land-use changes, greenhouse gas emissions, and resource extraction. Multiple strategies can be implemented to address these effects and promote biodiversity restoration. The agricultural and forestry sectors are significantly contributed to biodiversity loss, largely due to habitat conversion and pollution. Historically, they have contributed to considerable declines in terrestrial biodiversity, which are projected to continue unless sustainable practices are adopted (Kok et al., 2018; Dudley and Alexander, 2017; Chaudhary, Pfister and Hellweg, 2016). In addition, supply chains

and trade in industries such as food and chemicals have a substantial biodiversity footprint, often affecting regions abroad and complicating direct mitigation efforts (Wilting and Oorschot, 2017; Green et al., 2019; Chaudhary, Pfister and Hellweg, 2016). The mining and industrial sectors directly contribute to biodiversity loss by damaging ecosystems through habitat destruction and pollution. This makes restoration efforts essential but difficult because of the prolonged nature of ecosystem recovery (Prach and Tolvanen, 2016). Trade-driven industrial activities further intensify biodiversity loss, with significant consequences in areas far removed from consumption points, as seen in the production of commodities such as soy and palm oil (Xing and Wang, 2023; Green et al., 2019; Marques et al., 2019). Nature is a type of natural capital, offering crucial benefits for human health, prosperity, and overall well-being. However, economic activities that contribute to biodiversity loss, climate change and other forms of ecosystem damage have caused significant and costly declines in this natural capital which led us to draw on the natural capital-based view (NCBV).

The NCBV of the firm (Carvalho et al., 2022) was derived from Hart's (1989) NRBV of the firm, which incorporates the notion of natural elements (e.g. global biodiversity preservation and restoration) in a firm's strategy to gain an effective competitive advantage. The NRBV is a strategic framework that incorporates environmental factors into the traditional resource-based perspective on competitive advantage. It highlights the significance of a company's connection to the natural environment (Hart, 1995), which is essential to comprehend how companies can utilize their environmental strategies to secure a lasting competitive advantage. Carvalho et al. (2022).

Incorporating biodiversity considerations into corporate governance and reporting is crucial for attaining sustainable competitive advantage. The NCBV offers a useful framework for firms that intend to align their strategies with natural ecosystems. However, challenges such as inadequate disclosure practices and the intricate nature of biodiversity persist. Businesses, conservation scientists, and policymakers must collaborate to overcome these challenges and promote a more sustainable future. Our study addresses the following question: Should a company report on its impact on biodiversity loss and on activities to reduce this negative impact on the native ecosystems and species to improve its reputation and perform better? Our results reveal that companies disclosing biodiversity impact reduction, green revenues, and environmental, social, and governance (ESG)-related issues are, in fact, more likely to perform better financially.

This rest of the paper is structured as follows. Section 2 discusses the theoretical considerations and research questions. Section 3 presents the dataset and methodology utilised in this study. Section 4 reports and analyses the results. Lastly, Section 5 concludes the study and outlines its implications.

Literature review

Biodiversity reporting is gaining traction, as it enhances accountability and transparency in environmental practices. The emergence of frameworks such as nature-related Financial Disclosure (TNFD), as shown in Figure 1, reflects the growing awareness among stakeholders of the financial implications of biodiversity loss and ecological risks. Despite notable developments, the fact that management and financial academic communities have not fully engaged in biodiversity reporting suggests an opportunity for further research and integration of management and financial strategies. Various perspectives on nature-related disclosures, ranging from

measurement tools to determinants, indicate that this is a multifaceted issue that requires interdisciplinary collaboration.

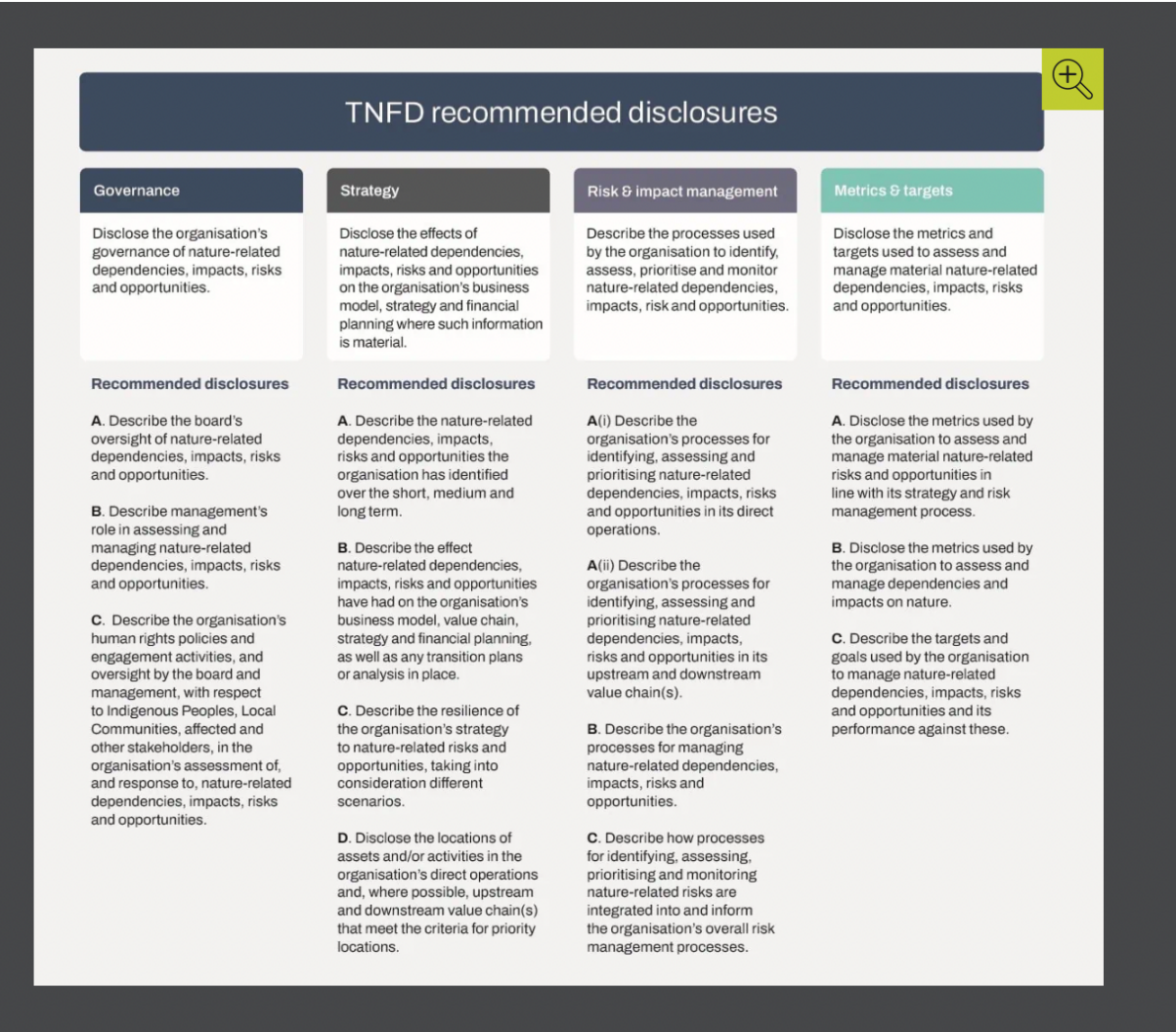


Figure 1: Taskforce on nature-related disclosures

Corporate governance and biodiversity disclosures

Boards play a crucial role in the management of biodiversity. The engagement of institutional investors, along with boards, in biodiversity disclosures reflects an increasing interest in corporate policies that prioritise the conservation and sustainability of biodiversity practices (Ali et al., 2023). This trend is further reinforced by the positive link between board gender diversity and biodiversity disclosures, implying that diverse boards may be more attuned to institutional pressure for

environmental accountability (Haque and Jones, 2020). In addition, investor demand fosters comparability and financial materiality in sustainability reporting, with common ownership helping mitigate concerns about disclosing sensitive information (Schiehlland Kolahgar, 2024). Our study elucidates the patterns of sectoral disclosure behaviour and clarifies how a growing group of influential market participants, namely common institutional owners, shape firms' commitment to investor-oriented disclosure practice

Similarly, Addison et al. (2018) analyse Fortune 100 companies and reveal that only a few companies provide specific, measurable, and time-bound biodiversity commitments. Furthermore, they find that only a few use quantitative indicators to verify their activities. Several factors influence the extent and quality of biodiversity reporting. For government organisations, factors such as the local council population, presence of environmentally oriented parties, and local environmental NGOs significantly affect biodiversity disclosure levels (Gaia and Jones, 2019). In the corporate sector, spatial characteristics and industry affiliation are significant predictors of biodiversity reporting, whereas organisational size only has a minimal impact (Skouloudis, Malesios and Dimitrakopoulos, 2019). The primary challenge in biodiversity reporting is the lack of standardised frameworks, except for the recently developed TNFD, and reliable measures for assessing biodiversity impacts. This results in sporadic and limited quantitative data, which makes it difficult to evaluate the effectiveness of corporate actions on biodiversity (Skouloudis, Malesios and Dimitrakopoulos, 2019; Addison et al., 2018). However, the need for science-based biodiversity commitments and meaningful indicators is increasingly being recognised, which presents an opportunity for conservation scientists to collaborate with businesses to enhance reporting practices (Addison et al., 2018).

In addition, to being part of the wider CSR, global biodiversity reporting is an essential component of corporate sustainability strategies. However, fear of litigation can discourage companies from disclosing biodiversity impacts; thus, proactive strategies are needed to mitigate litigation and reputational risks (Treepongkaruna, 2024). Despite the increasing importance of biodiversity, many companies still provide limited quantitative data on their biodiversity impacts, which hinders the assessment of their contributions to biodiversity conservation (Addison et al., 2018).

Biodiversity-related disclosures form part of a wider movement toward corporate social responsibility (CSR) reporting (Nguyen and Nguyen, 2023). The effects of these disclosures on financial markets, especially valuations, are investigated from various perspectives. Existing studies cover various areas, including how government-mandated CSR reporting and assurance frameworks influence stock prices (Desai, 2024; Pandey et al., 2024; Pandey and Kumari, 2024; Wang et al., 2023), the voluntary adoption of corporate reporting frameworks such as integrated reporting and their effects on a company's value (Hsiao et al., 2022), and the creation of CSR or sustainability reports (Wang and Li, 2016) and the specifics of their content (Qiu et al., 2016). Most of the studies' findings address CSR in general, CSR within the subcategories of ESG, or data related to carbon emissions (Alsaifi et al., 2020; Matsumura et al., 2014; Vestrelli et al., 2024). Only a few studies focus on biodiversity disclosures (Ali et al., 2023; Haque and Jones, 2020).

Biodiversity reporting across industries

Biodiversity reporting and accountability are becoming increasingly important as biodiversity decline poses significant risks to global ecosystem stability and

sustainable development. The corporate sector's role in biodiversity conservation is under scrutiny, with businesses being urged to account for and mitigate their impact on biodiversity through transparent reporting practices. Corporate biodiversity reporting is still in its nascent stages, with significant variation in the quality and comprehensiveness of disclosures across industries

Agriculture plays a central role in the global decline of biodiversity, particularly due to changes in land use and deforestation, particularly in tropical areas. The growth of agricultural exports from regions like Latin America, Africa, and Southeast Asia has resulted in considerable losses of species, frequently surpassing environmental limits. By sourcing agri-food products from areas rich in biodiversity, importing regions can mitigate their local effects, but this practice ultimately worsens the overall decline of global biodiversity (Pfister et al., 2024; Fick et al., 2019; Pfister et al., 2016). The use of **forest** land significantly contributes to the loss of species, especially in nations that possess rich biodiversity but have low timber production. The effects of the forestry industry are particularly pronounced in tropical areas, where many at-risk species are found (Pfister et al., 2016). Although **mining-related** land use accounts for less than 1% of the overall biodiversity loss linked to land use, it has substantial local effects, especially in places like Indonesia, Australia, and New Caledonia. The rising demand for minerals, particularly for infrastructure development and energy transitions, exacerbates these pressures. Notably, coal mining causes more harm per unit of electricity generated compared to renewable energy sources (Pfister & Cabernard, 2022; Ekstrom et al., 2014). The **energy** sector, particularly coal-fired power generation, has a significantly greater negative effect on biodiversity than renewable energy sources. Shifting to renewable energy can help mitigate biodiversity loss associated with mining; however, the development of infrastructure still presents

potential risks (Pfister & Cabernard, 2022). **Industrial agglomeration**, fuelled by global trade, actively contributes to the acceleration of biodiversity loss, both directly and indirectly. The extent of this impact varies depending on the efficiency of the green economy, which can lessen the negative effects in certain areas while failing to do so in others (Xing & Wang, 2023). **Financial institutions** are becoming more vulnerable to biodiversity risks within their investment portfolios. Companies that overlook the impacts on biodiversity may experience financial difficulties, prompting investors to take into account not only direct biodiversity issues but also those related to supply chains (Kulionis et al., 2024). The flow of goods through global supply chains connects consumption in developed nations to biodiversity loss in producing regions, thereby increasing the global impact of trade (Pfister et al., 2024; Fick et al., 2019). Although **tourism** is frequently associated with land-use changes and resource consumption, which indirectly leads to biodiversity loss in vulnerable areas.

Biodiversity reporting and accountability are crucial for sustainable development; however, current practices are inadequate and inconsistent. Standardised reporting frameworks and more robust measures are needed to ensure that businesses and government organisations can effectively communicate their biodiversity impacts and contributions. Enhanced collaboration between conservation scientists and businesses could help improve biodiversity reporting and thus support global biodiversity conservation efforts. Ultimately, no corporate actors can ignore the significance of natural capital.

NCBV and biodiversity

As mentioned earlier, Carvalho et al.'s (2022) NCBV was derived from the NRBV, which is a strategic framework that integrates environmental considerations

into the resource-based view of competitive advantage. Meanwhile, challenges such as limited disclosure compounded by the inherent complexity of biodiversity issues remain. Hence, the complexity of biodiversity issues and lack of corporate commitment are significant obstacles to effective biodiversity management. Top management team (TMT) involvement and organisational citizenship behaviours are critical for internalising biodiversity practices within firms (Boiral et al, 2019). Moreover, the integration of biodiversity and ecosystem services into economic reporting is gaining international support, emphasising the need for comprehensive and transparent reporting systems (Grunewald et al., 2024). Natural capital, which views the environment as stocks of natural resources that provide valuable environmental goods and ecosystem services for the economy and society, has been a fundamental principle in environmental and ecological economics in the past thirty years (Costanza and Daly, 1992; Pearce, 1988). Nevertheless, this concept has only gained significant traction within the corporate world recently. As such, concerted efforts from businesses, conservation scientists, and policymakers are needed to address these challenges and foster a more sustainable future.

Therefore, we propose the following hypothesis:

A company would disclose its impact on biodiversity and its activities to reduce its negative impact on native ecosystems and species as well as on the biodiversity of protected and sensitive areas, to improve its reputation and financial health.

We use the following model specification to answer our research questions:

Biodiversity impact reduction = f(B_gender, B_size, B_tenure, B_Specific Skills, TMT Gender, R&D, CompGreenRevenue, ESG_score, CSR Sustainability Score, Lnassets, debt_capital, ROA, Industry, Country)

Data and methodology

We use a global sample of companies listed on stock exchanges across 59 countries from 2015 to 2023. Our sample selection is used to examine (1) the relationship between reduced biodiversity impact reduction scores by country and industry; (2) the relationship between reduced biodiversity impact and communication reporting; and (3) the relationship between biodiversity impact reduction and board disclosures. Initially, we compiled a list of publicly traded companies and remove companies with incomplete data or missing information during the analysis period. This process yields 2,779 companies. Then, we gather information on company characteristics from London Stock Exchange Group (LSEG) data and analytics; country data from the World Bank database, yielding 28,150 observations.

We collect three data types. First, we examine the relationship between biodiversity impact reduction and communication reporting through company green revenues and R&D expenses. Second, we obtain sustainability performance by combining ESG score and the CSR external audit score. Third, we gather company characteristics, namely, board size, director-specific skills (environment-related skills), board tenure, board gender diversity, TMT diversity, Assets and EBITDA. Finally, country characteristics. Ethical clearance required for the use of secondary data from the LSEG and the World Bank were obtained from the University of Bradford. Table 1 presents the variables in this study.

Data and Methodology

We use a global sample of companies listed on stock exchanges across 59 countries, spanning the years 2015 to 2023. Our sample selection serves three roles: first, to examine the relationship between reduced biodiversity impact reduction scores by country and industry (Figures 2 and 3); second, to assess the relationship between

reduced biodiversity impact and communication reporting and third to assess the relationship between biodiversity impact reduction and board disclosures.

First, we compiled a list of all companies that are publicly traded on their respective stock exchanges. Second, we removed those companies that had incomplete data or were missing information during the analysis period. This resulted in a sample of 2,779 companies that were active over the nine-year timeframe we examined. Thirdly, during our data collection, we gathered information about company and country characteristics from LSEG and the World Bank database respectively, yielding a total of 28,150 observations.

We collected three types of data: Firstly, we examined the relationship between biodiversity impact reduction and communication reporting through Company Green Revenues and R&D expenses. Secondly, Sustainability Performance was represented by the combined Environmental, Social, and Governance (ESG) scope and the CSR external audit score. We gathered company characteristics, namely board size, directors specific skills (environmental related skills), board tenure, board gender diversity, TMT diversity, Total Assets and EBITDA. Finally, we source country data, namely, GDP, Government Effectiveness and Regulatory Quality. The required ethics clearance for the use of secondary data from LSEG and the World Bank databases were obtained from the University of Bradford. The complete list of variables is provided in Table 1. Figure 2 presents the Biodiversity Impact Reduction scores disclosed by the 59 countries and figure 3 presents the Biodiversity Impact Reduction scores of the 11 industries from 2015 to 2023. Figure 4 presents the Biodiversity Impact scores for the year 2015 and 2023.

Dependent Variable

For each company, we match the biodiversity reduction impact score collected from LSEG, which reveals if the company has mentioned in its annual or sustainability reports any efforts aimed at promoting the recovery and safeguarding of biodiversity.

Independent Variables

1.Capability Related Variables

The 'Company Green Revenues' percentage which is the reported or estimated green revenue as a proportion of total revenue and the 'R&D Expenses' which is the Research and Development expenses incurred for a given year.

2. Communication Related Variables

The inclusion of data from an external audit of the company's 'CSR information' and/or supplementary financial reports is taken into account. This may also involve reviews conducted by universities, academics, experts, external panels, or research institutions, as well as web-based CSR reports that have undergone external audits or integrated annual reports containing external audit statements related to their environmental and social data.

3. ESG reporting scope

The proportion of the company's activities included in its 'Environmental, Social and Governance Reporting' takes into account the scope reported by the company, specifically the percentage of activities covered in its environmental and social reports. This includes assessing whether the extra financial reporting encompasses all global operations. To evaluate this, we will follow the priority order below: 1. Percentage of employees covered; 2. Percentage of revenue covered and 3. Percentage of operations covered.

In cases where there are two distinct scopes for social and environmental coverage, we will consider the lower value between the two.

4. Country Level

Gross Domestic Product (GDP)

There has been a resurgence of interest in expanding the national income and wealth accounting systems at a macroeconomic level—systems that report on gross domestic product (GDP and other indicators—to incorporate the value of ecosystem services and natural capital. The United Nations and the World Bank (Lange, Wodon and Carey, 2018 in Polasky and Daily, 2021).

Government Effectiveness

Government Effectiveness encompasses the perceptions and opinions regarding the standard of public services, the quality of the civil service and its autonomy from political influence, the effectiveness of policy development and execution, as well as the trustworthiness of the government's dedication to these policies (World Bank, 2025).

Regulatory Quality

Regulatory Quality reflects perceptions regarding the government's capacity to create and enforce effective policies and regulations that foster and support private sector growth. The estimates offer a country's score on this overall indicator, measured on a scale of a standard normal distribution from roughly -2.5 to 2.5 (World Bank, 2025).

Control Variables

This value represents Earnings Before Interest, Taxes and Depreciation expressed as a percent of Total Revenue (EBITDA).

'Total Assets' represents the total assets reported by a company. In case the Total Assets was not reported, it would be the sum of the following items: Total Current Assets and Total Non-Current Assets.

We have undertaken the required descriptive statistics and correlation. Additionally, we carried out the random and fixed effects panel regressions, but we are yet to analyse the results in detail.

Table 1: Variables in the econometric analysis

Variable	Definition of variables
Biodiversity Impact Reduction	Biodiversity impact reduction by a company measured with the following variables: 1) An integer variable denoting the score of biodiversity impact reduction (Bio_reduction). 2) A binary variable representing biodiversity impact reduction (Bio_reductionbin)
Company Green Revenues	Reported or estimated green revenue as a proportion of total revenue
R&D Expenses	Research and development expenses on new products and services only
ESG	LSEG ESG combined score of the company ESG performance controlling for ESG controversies reported by third parties
GDP	Gross Domestic Product per Capita
Government Effectiveness	Captures perceptions of the quality of public services, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
Regulatory Quality	Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
CSR Sustainability Score	Board level or TMT Committee responsible for decision making on CSR Strategy
Board Gender Diversity (B_gender)	An integer variable depicting the percentage of female directors on board
Gender Diversity in the Top Management Team (TMT)	An integer variable depicting the percentage of female director on TMT
Size	Company size measured by natural logarithm of assets
Total Assets	Financial performance as measured by total assets
EBITDA	Earnings before interests, taxes, depreciation and amortization
B_size	The number of directors on the board
B_tenure	The average tenure of board directors
B_affiliations	The number of affiliations by board directors
Industry	The eleven industries present in the population

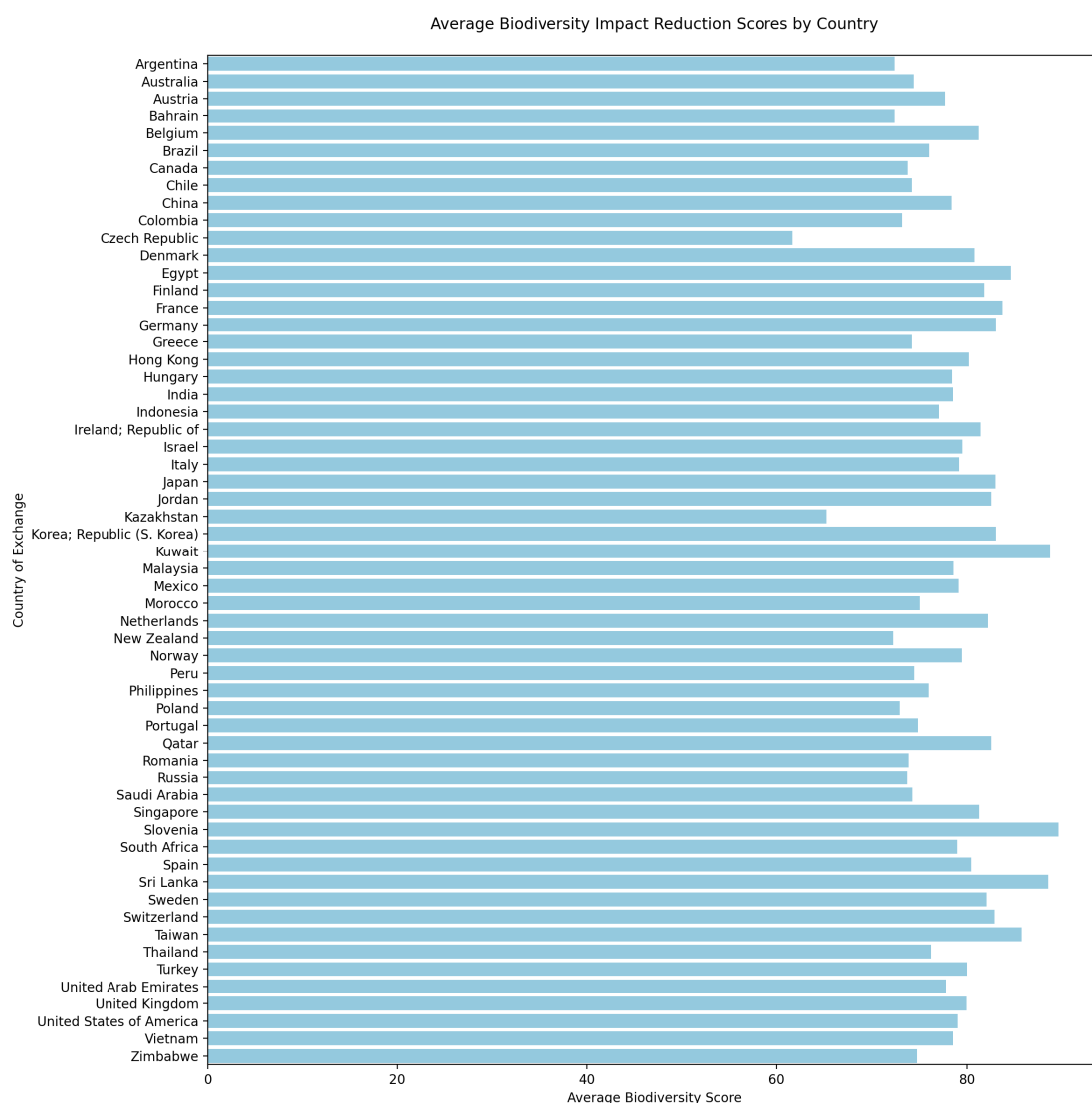


Figure 2 presents the biodiversity impact reduction scores disclosed by the 59 countries (2015 – 2023).

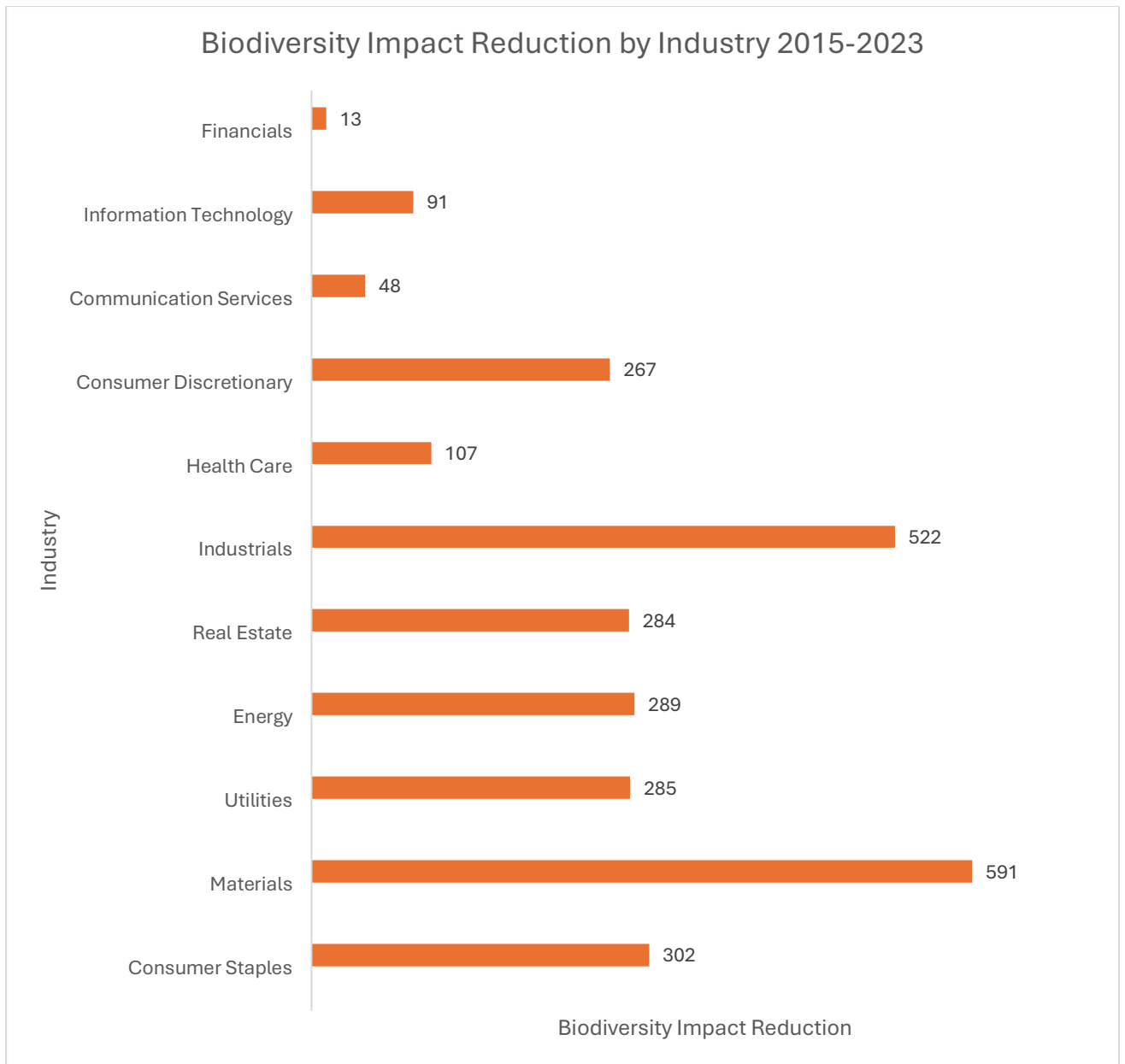


Figure 3 presents the biodiversity impact reduction scores of the 11 industries from 2015 to 2023.

Lastly, Figure 4 shows the biodiversity impact scores for 2015 and 2023.

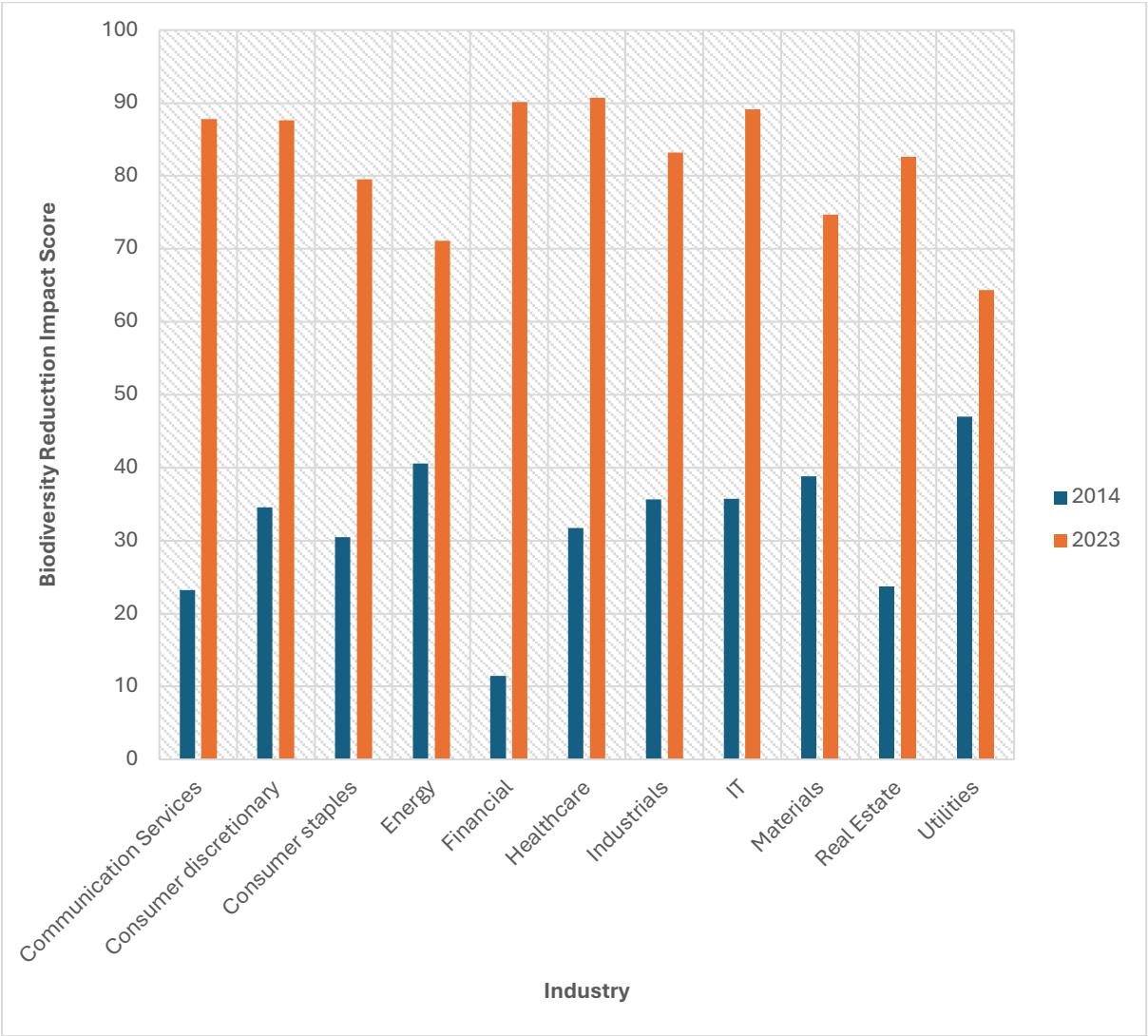


Figure 4: Biodiversity impact reduction scores by industry 2015 and 2023

Table 2. Descriptive Statistics and Correlations

Variables		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Biodiversity Reduction Impact Score	1.00														
2	Board Specific Skills	-0.05	1.00													
3	Company Green Revenues	0.05	-0.03	1.00												
4	ESG Reporting Scope	-0.07	-0.10	0.04	1.00											
5	CSR Sustainability External Audit Score	0.26	-0.05	0.00	-0.08	1.00										
6	Government effectiveness	-0.06	0.26	0.04	-0.11	0.02	1.00									
7	Regulatory Quality	-0.05	0.19	0.04	-0.03	0.02	0.92	1.00								
8	GDP per capita	-0.03	0.18	0.05	0.03	0.01	0.83	0.84	1.00							
9	R&D expenses	0.08	-0.02	-0.04	0.05	0.15	0.11	0.12	0.18	1.00						
10	EBITDA margin	0.02	0.00	0.01	-0.01	0.02	-0.01	-0.02	-0.01	0.00	1.00					
11	Total Assets	0.05	-0.01	-0.03	-0.01	0.19	0.01	0.00	0.04	0.54	0.00	1.00				
12	Total Investments	0.01	0.03	-0.02	-0.02	0.09	0.07	0.07	0.08	0.46	0.00	0.55	1.00			
13	Board Size	0.10	-0.11	0.02	-0.07	0.19	-0.07	-0.12	-0.12	0.09	0.03	0.15	0.07	1.00		
14	Average Board Tenure	-0.04	0.08	0.01	0.00	-0.07	0.04	0.06	0.06	0.04	0.02	-0.02	0.03	0.03	1.00	
15	Board Gender Diversity	0.16	-0.16	0.07	0.17	0.16	0.12	0.20	0.26	0.14	0.01	0.04	0.02	0.04	-0.03	1.00
Observations		19,491	18,051	20,502	15,082	12,855	25,315	2	25,308	6,683	24,576	24,809	20,357	18,050	17,454	18,037
Mean		54	48	11	87	50	1	1	4E+04	5E+08	-3	2E+10	1.8E+09	10	7	18
Standard Deviation		39	23	24	25	40	1	1	2E+04	2E+09	214	6E+10	8.1E+09	3	4	18
Minimum		0	0	0	0	0	-1	-2	1E+03	0	-3E+04	1E+04	0	1	0	0
Maximum		98	100	0	0	99	2	2	1E+05	7E+10	276	5E+12	5.6E+11	98	30	100

Notes

Coefficients that are significant at the 5% level are indicated in bold

Table 3: Random Effects panel regression estimates predicting Biodiversity Impact Reduction Score

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	Controls Only		Model 1+ board capabilities		Model 2 + Sustainability experience		Model 3 + Regulatory quality + GDP/Capita		Model 4 + Government effectiveness	
Board Specific Skills			0.10 ***		0.107 ***		0.108 ***		0.102 ***	
			0.03		0.040		0.040		0.040	
Company Green Revenues					0.119 ***		0.114 ***		0.119 ***	
					0.044		0.044		0.044	
ESG Reporting Scope					-0.037		-0.035		-0.040	
					0.028		0.028		0.028	
CSR Sustainability External Audit Score					0.134 ***		0.135 ***		0.136 ***	
					0.021		0.021		0.021	
Govt effectiveness									7.698 *	
									3.995	
Regulatory Quality							5.360			
							5.001			
GDP per capita							6.8E-04 ***			
							2.1E-04			
R&D expenses	8.6E-10 **		8.7E-10 **		5.3E-10		4.2E-10		5.4E-10	
	3.6E-10		3.6E-10		4.2E-10		4.2E-10		4.2E-10	
EBITDA Margin	-1.8E-03		-1.8E-03		2.1E-01		2.3E-01		3.2E-01	
	2.1E-02		2.1E-02		2.2E+00		2.2E+00		2.2E+00	
Total Assets	4.4E-11 **		4.4E-11 **		3.1E-11		3.3E-11		3.0E-11	
	2.1E-11		2.1E-11		2.5E-11		2.5E-11		2.5E-11	
Total Investments	-1.8E-10 *		-1.8E-10 *		-2.3E-10 **		-2.1E-10 **		-2.3E-10 **	
	9.5E-11		9.5E-11		1.1E-10		1.1E-10		1.1E-10	
Board Size	0.284		0.284		0.088		0.044		0.070	
	0.223		0.223		0.258		0.307		0.258	
Average Board Tenure	0.337		0.337		0.215		0.254		0.245	
	0.255		0.255		0.308		0.307		0.308	
Board Gender Diversity	0.093		0.093		0.013		0.031		0.019	
	0.067		0.067		0.083		0.083		0.083	
Country controls	Yes		Yes		Yes		Yes		Yes	
Year controls	Yes		Yes		Yes		Yes		Yes	
Industry controls	Yes		Yes		Yes		Yes		Yes	
Intercept	82.18 ***		76.04 ***		78.12 ***		25.160		68.24 ***	
	8.88		9.13		11.38		18.653		12.50	
Observations	4351		4351		2877		2876		2876	
Overall R-sqd	0.198		0.200		0.162		0.166		0.163	

Notes ***p < 0.01, **p < 0.05, *p < 0.1 (z-statistics)

Standard errors under the coefficients

Table 4: Fixed Effects panel regression estimates predicting Biodiversity Impact Reduction Score

Variable	Model 1b	Model 2b	Model 3b	Model 4b	Model 5b
	Controls only	Model 1b + board capabilities	Model 2b + Sustainability experience	Model 3 b + Regulatory quality + GDP/Capita	Model 4 b + Government effectiveness
Board Specific Skills		0.107 ***	0.137 ***	0.138 ***	0.131 ***
		0.035	0.044	0.044	0.044
Company Green Revenues			0.164 **	0.158 **	0.168 **
			0.067	0.067	0.067
ESG Reporting Scope			-0.035	-0.034	-0.040
			-0.035	0.032	0.032
CSR Sustainability External Audit Score			0.104 ***	0.104 ***	0.106 ***
			0.025	0.025	0.025
Government effectiveness					7.845 *
					4.164
Regulatory Quality				4.096	
				5.149	
GDP per capita				6.0E-04 ***	
				2.2E-04	
R&D expenses	1.7E-09 ***	1.7E-09	9.6E-10	8.0E-10	1.0E-09
	4.7E-10	4.7E-10	6.7E-10	6.7E-10	6.7E-10
EBITDA Margin	-1.0E-03	-5.8E-03	-2.9E+00	-2.9E+00	-2.7E+00
	1.1E-01	1.1E-01	3.0E+00	3.0E+00	3.0E+00
Total Assets	-9.4E-11 **	-9.5E-11 **	-3.5E-11	-3.3E-11	-4.0E-11
	3.8E-11	3.8E-11	4.8E-11	4.8E-11	4.8E-11
Total Investments	-1.1E-10	-1.1E-10	-3.3E-10 *	-3.0E-10 *	-3.4E-10 *
	1.5E-10	1.5E-10	1.8E-10	1.8E-10	1.8E-10
Board Size	0.019	0.087	0.037	-0.009	0.021
	0.279	0.280	0.320	0.320	0.320
Average Board Tenure	0.914 ***	0.906 ***	0.490	0.514	0.535
	0.349	0.349	0.415	0.415	0.415
Board Gender Diversity	0.027	0.043	0.015	0.036	0.023
	0.079	0.079	0.095	0.095	0.095
Country controls	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes
Intercept	80.68 ***	74.35 ***	68.24 ***	40.86 ***	59.23 ***
	4.35	4.81	6.59	11.71	8.14
Observations	4351	4351	2877	2876	2876
F	77.83 ***	73.72 ***	24.05 ***	22.26 ***	23.05 ***
Overall R-sqd	0.078	0.081	0.074	0.036	0.059

Notes ***p < 0.01. **p < 0.05, *p < 0.1 (t-statistics)

Standard errors under the coefficients

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Table 2: Descriptive statistics and correlations

Variables	1	2	3	4	5	6	7	8	9	10	11	12
Biodiversity Reduction												
1 Impact Score	1.000											
Company Green												
2 Revenues	0.046	1.000										
3 R&D expenses	0.084	-0.037	1.000									
4 ESG Reporting Scope	-0.065	0.041	0.042	1.000								
CSR Sustainability												
5 External Audit Score	0.264	0.008	0.138	-0.076	1.000							
6 Board Size	0.098	0.016	0.088	-0.072	0.172	1.000						
7 Board Specific Skills	-0.046	-0.029	-0.021	-0.103	-0.042	-0.108	1.000					
8 Average Board Tenure	-0.036	0.008	0.041	0.004	-0.077	0.032	0.082	1.000				
Board Gender												
9 Diversity	0.162	0.072	0.130	0.168	0.163	0.030	-0.152	-0.034	1.000			
1 Executive Members												
0 Gender Diversity	0.055	0.031	0.091	0.162	0.056	-0.025	-0.067	0.044	0.386	1.000		
1												
1 EBITDA Margin	0.017	0.007	0.004	-0.006	0.015	0.024	0.000	0.016	0.013	-0.010	1.000	
1												
2 Total Assets	0.055	-0.024	0.534	-0.014	0.184	0.160	-0.004	-0.025	0.038	-0.009	0.004	1.000
Observations	19494	23040	7480	17854	17854	14805	20891	20233	20877	20867	27387	27649
Mean	5.4E+01	1.1E+01	5.1E+08	8.8E+01	8.8E+01	5.2E+01	4.8E+01	6.9E+00	1.9E+01	1.4E+01	2.8E+00	1.6E+10
Standard Deviation	3.9E+01	2.4E+01	2.3E+09	2.5E+01	2.5E+01	3.9E+01	2.2E+01	3.6E+00	1.4E+01	1.4E+01	2.0E+02	6.1E+10

Table 3: Regression models

Variables	Model 1	Model 2	Model 3	Model 4
	Control s Only	Model 1 + Capabil ity	Model 2 + Communica tion Reporting	Model 3 + Board
Company Green Revenues		** 0.498 * (0.057)	** 0.427 * (0.059)	** 0.387 * (0.061)
R&D expenses		1.3E-09 ** (5.7E-10)	1.5E-09 ** (7.0E-10)	1.4E-09 ** (6.9E-10)
ESG Reporting Scope			** -0.099 * (0.032)	** -0.095 * (0.032)
CSR Sustainability External Audit Score			** 0.195 * (0.025)	** 0.169 * (0.025)
Board Size				-0.404 * (0.231)
Board Specific Skills				** 0.129 * (0.043)
Average Board Tenure				-0.034 (0.402)
Board Gender Diversity				** 0.685 * (0.082)
Executive Members Gender Diversity				0.180 ** (0.084)
EBITDA Margin	1.3E-03 (2.0E-03)	1.8E-03 (2.6E-02)	-0.410 (3.224)	-1.028 (3.164)
Total Assets	1.8E-11 ** (4.9E-12)	1.6E-10 ** (4.2E-11)	9.1E-11 ** (4.5E-11)	2.3E-11 (4.6E-11)

		**		**		**		**
Intercept	54.049	*	46.025	*	51.414	*	40.356	*
	(0.239)		(1.156)		(3.376)		(5.724)	
Observations	19195		5167		3361		3249	
F	6.84	**	32.96	*	27.68	*	25.06	*
	0.0032		0.0112				0.0340	
Overall R-sq	00		00		0.029900		00	

Dependent Variable: Biodiversity

Impact Reduction Score

DV from 2014 to 2023

Standard errors in parentheses reported
under the coefficients.

*** $p < 0.01$. ** $p < 0.05$,

* $p < 0.1$