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# Regulatory influence, board characteristics and climate change disclosures: evidence from environmentally sensitive firms in developing economy context

Anup Kumar Saha and Imran Khan

## Abstract

**Purpose** – This study aims to examine the impact of board characteristics on climate change disclosures (CCDs) in the context of an emerging economy, with a unique focus on regulatory influences.

**Design/methodology/approach** – This study analyzes longitudinal data (2014–2021) from environmentally sensitive firms listed on the Dhaka Stock Exchange, using a disclosure index developed within the Global Reporting Initiative framework. The authors use a neo-institutional theoretical lens to explore regulatory influences on CCD through board characteristics. This study uses hand-collected data from annual reports owing to the absence of an established database.

**Findings** – The results indicate that a larger board size, the presence of foreign directors and the existence of an audit committee correlate with higher levels of CCD disclosure. Conversely, a higher frequency of board meetings is associated with lower CCD disclosure levels. This study also observed an increase in CCD following the implementation of corporate governance guidelines by the Bangladesh Securities and Exchange Commission, albeit with a relatively low number of firms making these disclosures.

**Research limitations/implications** – This study contributes to the climate change reporting literature by providing empirical evidence of regulatory influences on CCD through board characteristics in an emerging economy. However, the findings may not be universally applicable, considering the study's focus on Bangladeshi listed firms.

**Practical implications** – This study suggests growing pressures for diverse stakeholders, including researchers and regulatory bodies, to integrate climate change disclosure into routine activities. This study offers a valuable framework and insights for various stakeholders.

**Social implications** – By emphasizing the influence of good governance and sustainability practices, this study contributes to stakeholders' understanding, aiming to contribute to a better world.

**Originality/value** – This study stands out by uniquely positioning itself in the climate change reporting literature, shedding light on regulatory influences on CCD through board characteristics in the context of an emerging economy.

**Keywords** Climate change disclosure, Corporate governance, Board characteristics, Regulatory influence, Neo-institutional theory

**Paper type** Research paper

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The authors declare no conflict of interest.

## 1. Introduction

Climate change disclosure (CCD) has emerged as a critical focus for scholars, researchers, policymakers and regulators in recent decades (Adams *et al.*, 2020; Jiang *et al.*, 2021),

gaining prominence among environmentally sensitive firms. The escalating global emissions of greenhouse gases pose severe threats to the environment, economic systems and human lives (Goworek *et al.*, 2018; Sun *et al.*, 2020). In response, international and national organizations have introduced various initiatives, policies and practices to combat climate change (Baboukardos *et al.*, 2021; Gaganis *et al.*, 2021). Notable among these are the 1997 Kyoto Protocol and the 2015 Paris Agreement, significant international accords designed to reduce greenhouse gas emissions and enhance climate change resilience (Luo and Tang, 2021). At the national level, countries such as Denmark, Malaysia, China, Brazil, South Africa and Spain have implemented mandatory climate standards, indicating a global shift in their regulatory frameworks (Simpson *et al.*, 2021). In Bangladesh, the Securities and Exchange Commission introduced regulations<sup>[1]</sup> and guidelines, including the Corporate Governance Code (CGC), underscoring the increasing importance of regulatory perspectives in emerging nations (Brooks and Oikonomou, 2017).

Despite the growing significance of climate change, firms face mounting pressure from stakeholders to disclose their environmental impacts and engage in decarbonization initiatives (Alsaifi *et al.*, 2019; Backman *et al.*, 2017). This pressure is intertwined with regulatory initiatives, shaping the strength of climate disclosure as a value-creating strategy to showcase stakeholders' oversight and accountability to stakeholders (Hollindale *et al.*, 2019). Surprisingly, limited attention has been paid to exploring how regulatory initiatives influence CCDs and contribute to sustainable business practices (Luo and Tang, 2021). This study aims to fill this gap by examining the regulatory influence on climate disclosure.

While various justifications exist for firms engaging in CCD initiatives (Young and Marais, 2012), a crucial theoretical development suggests that the institutional context and theory can offer insights into the surge in climate disclosure activities (Bui *et al.*, 2020). Firms engaging in environmental practices respond to stakeholder pressures and expectations from both internal (e.g. investors, personnel, management) and external (e.g. customers, suppliers, society, regulators) perspectives (Donaldson and Preston, 1995; Mahadeo *et al.*, 2011). Additionally, firms disclose climate change to maintain reporting accountability, reduce information asymmetry and manage managerial impressions (Al-Shaer and Zaman, 2018). External stakeholders, especially regulators, exert pressure on firms through regulations and guidelines (Helfaya *et al.*, 2019; Jizi, 2017). The signaling theory posits that environmentally sensitive firms with significant carbon exposure are likely to extensively report CCD to highlight their positive performance to stakeholders. The neo-institutional theory further contends that institutional forces can interact to shape, control and/or enable the adoption of business practices and innovations (DiMaggio and Powell, 1983; Scott, 2013). However, there is a dearth of knowledge regarding the institutional influence that drives the rapid expansion of CCD among firms (Ntim and Soobaroyen, 2013).

This study seeks to extend and apply neo-institutional theory to elucidate the amplification of CCD practices at the organizational level. Firms sharing a CCD under greater legitimacy are more likely to conform to expected social behavior because of regulative institutional pressures (Datt *et al.*, 2019). The alignment of company objectives and standards with broader societal norms, facilitated by compliance with adequate CCD practices, enhances organizational legitimacy (Ntim and Soobaroyen, 2013). Corporate legitimacy fosters positive relationships with influential stakeholders, such as governments, politicians, shareholders and trade unions (Aguilera *et al.*, 2007). Given regulatory responsiveness to climate issues and their consequences for firms (Choi and Luo, 2021), exploring how regulatory initiatives influence CCD is crucial.

Furthermore, the efficiency perspective of the neo-institutional theory posits that regulatory, cognitive and normative institutional pressures can compel businesses to access vital resources, safeguard shareholder interests and maximize corporate performance (Aguilera *et al.*, 2007; Chen and Roberts, 2010; Grecco *et al.*, 2013). Commitment to CCD can enhance corporate efficiency by reducing agency conflicts and minimizing information

asymmetry between managers and stakeholders (Rhodes, 2010). Considering the intricate nature of CCD practices and their associated consequences (Devinney, 2009), there is a growing consensus that regulatory perspectives require closer examination (Zattoni and Cuomo, 2008).

The literature emphasizes the need for studies in emerging economies, such as Asia, to provide fresh perspectives on climate-related challenges (Brooks and Oikonomou, 2017). This study focuses on Bangladesh, a rapidly expanding country in Asia that is undergoing industrialization, albeit with adverse environmental and public health consequences (Elmagrhi *et al.*, 2019). For instance, the textile factory[2] disaster in Bangladesh has fomented the global outcry (Siddiqui and Uddin, 2016), causing severe threats to foreign investment, ready-made garments and industry contracts (Khan *et al.*, 2013). Notably, environmentally sensitive firms (Elmagrhi *et al.*, 2019), primarily responsible for significant climate damage between 2014 and 2021, are explored to understand the impact of regulatory influence on CCD.

Previous studies have emphasized the significance of corporate governance (CG) in developing climate change initiatives and strategies that provide value to shareholders (Luo and Tang, 2021). For example, effective CG can improve accountability for the environmental footprint by advocating environmentally responsible actions to control environmental risks efficiently and effectively (Harjoto *et al.*, 2015). In this regard, CG characteristics (i.e. board size, independence, diversity, audit committee and meetings) play an influential role in practicing climate disclosure, supported by the argument of Sullivan and Gouldson (2017), who suggested that corporate responses to climate change and performance outcomes are interrelated and interdependent; therefore, it is important to assess them as a comprehensive, dynamic and interactive system. This study addresses this research gap by examining the impact of board characteristics on CCD in an emerging country context.

Despite the recent surge in the scrutiny of sustainable business practices in developing countries, Bangladeshi companies remain skeptical about their CCD (Belal and Cooper, 2011; Elfeky and Nasiri, 2017). Regulatory authorities, including the Ministry of Environment and Forest and the Bangladesh Securities and Exchange Commission (BSEC), have introduced various laws and guidelines promoting good environmental practices, yet poor enforcement has hindered their implementation (i.e. the Bangladesh Environment Conservation Act and Corporate Governance Guidelines 2012[3]). Strengthening internal governance structures is crucial for promoting the adoption of climate-friendly strategies (García-Martín and Herrero, 2020). For instance, having an appropriate board size, increasing board gender diversity, having independent and foreign directors, having an audit committee and initiating frequent board meetings play influential roles in ensuring organizational legitimacy through climate disclosure (Khan *et al.*, 2013; Ntim *et al.*, 2013). There is a dearth of empirical research addressing how regulators affect CCD among mindful firms, despite the significance of governance structures for fostering adherence to climate-friendly practices (Nguyen *et al.*, 2021), which provides a wonderful opportunity to contribute something new to the existing literature. This study explores how regulators influence CCD among mindful firms by considering the significance of governance structures in fostering adherence to climate-friendly practices.

This study contributes novel findings to the literature on climate disclosure. It examines the effects of regulatory influence on CCD through the lens of a CG matrix, focusing on an emerging country context (i.e. Bangladesh). While previous research has predominantly explored the impact of carbon emissions on financial performance (Lewandowski, 2017), limited attention has been paid to regulatory influence on CCD in the context of developing economies. For instance, empirical evidence indicates that companies with more independent boards and a higher proportion of women on their boards tend to implement more comprehensive climate initiatives (Al-Shaer and Zaman, 2019; Amran *et al.*, 2014;

[Haque, 2017](#)). According to [Haque and Ntim \(2018\)](#), companies with less effective CG have lower actual CCD than well-governed competitors. In this instance, an emerging country analysis of environmentally sensitive firms can help explain the mixed findings documented in prior literature.

The remainder of this paper is organized as follows. Section 2 provides the background for this study. Section 3 presents a theoretical literature review that guides this study. Section 4 reports a condensed empirical literature review and hypothesis development. Section 5 outlines the research design of this study. Section 6 presents the empirical results and a discussion. Section 7 provides the summary and concluding remarks.

## 2. Background

CG encompasses various definitions, with the Cadbury Report 1992 in the UK offering a widely recognized definition, framing it as a system for managing and controlling companies ([FRC, 2018](#)). Driven by the global imperative for effective governance, Bangladesh implemented mandatory regulations in 2012, issuing Corporate Governance Guidelines (CGG) through the Bangladesh Securities and Exchange Commission ([Securities and Exchange Commission, 2012](#)). The Securities and Exchange Commission was founded on June 8, 1993, and underwent a name change to the Bangladesh Securities and Exchange Commission on December 10, 2012. These guidelines cover key principles under seven heads, including 95 conditions and one annexure, addressing concerns such as board size, independent directors and board meetings. The detailed guidelines (CGG, 2012) cover the board's size, pointing to the maximum and minimum number of independent directors, highlighting the qualifications of independent directors, the duality of the chairman of the board and chief executive officer and the establishment of an audit committee on the board composed of at least one independent director.

However, inconsistencies arose in some principles, including board size, independent directors and board meetings, particularly in the banking, non-bank finance and insurance sectors. For instance, board size and appointing independent directors, where immediate executives used to be appointed, caused a threat to independence. This prompted reforms in the 2018 CGC ([Bangladesh Securities and Exchange Commission, 2018](#)). The new code (CGC, 2018), comprising 166 conditions under nine heads and three annexures, aimed to enhance governance transparency and accountability for shareholders and stakeholders alike ([Aguilera and Cuervo-Cazurra, 2009](#)). The 2018 CGC introduced 62 new conditions, along with four conditions from the 2012 CGG, split into 13 separate conditions.

Noteworthy changes include the specifications of board composition, qualifications for independent directors and additional conditions regarding the duality of chairpersons and directors' reports to shareholders. To address concerns about independence, the CGC improved the appointment of independent directors, eliminating threats to independence. First, it uniquely guides all companies to organize a board with a specific number of directors (the CGC, Provision 1.1) by eliminating earlier inconsistencies with any other primary regulator. Second, clarity on independent directors' qualifications is incorporated to ensure greater independence (CGC, Provision 1.2). Third, two new conditions with further explanation are integrated into the duality of the chairperson of the board of directors and the managing director or chief executive officer. To outline the directors' report to shareholders, 11 new conditions are added (the CGC, Provision 5), including protection for minority shareholders, an interim bonus share, a detailed company position, etc. In addition, four existing conditions are improved with the aim of bringing more clarity to the disclosure of risk factors, profits, gains and related parties. In addition, for accountability, a new condition is included in the CGC to conduct board meetings and formally record the minutes of the meetings. To ensure that the audit committee is structured with the right mix of professional skills and experience, the CGC 2018 included new conditions for the determination of the chairperson, the minimum four meetings in a financial year, the quorum

of the meeting and the role of the committee. In addition, CGC 2018 also highlights a new head called the nominations and remuneration committee, with the nomination criteria or policy for determining the qualifications, positive attributes, experiences and independence of directors and top-level executives. CGC 2018 includes additional provisions concerning external or statutory auditors to prevent conflicts of interest and their presence in annual general meetings or extraordinary general meetings. In terms of disclosure, CGC 2018 introduced a requirement for companies to maintain an official website, operational from the date of listing, for detailed disclosures. To ensure compliance, the CGC 2018 mandates that firms obtain certificates that confirm adherence to the CGC. This certificate was issued by a professional appointed by shareholders during an annual general meeting.

The significance of the CGC 2018 extends beyond mere regulatory compliance. Focusing on maintaining an official website, obtaining compliance certificates and addressing potential conflicts of interest, the CGC anticipates a profound impact on companies' responses to establishing a corporate culture that prioritizes integrity and addresses climate change risks (Luo and Tang, 2021). This regulatory shift is expected to build stakeholders' trust in the basic framework of the amended CGC 2018, thereby influencing their decision-making processes.

In summary, the evolution from CGG to CGC reflects a transformative journey in CG in Bangladesh. These regulatory changes, particularly the 2018 CGC, lay the groundwork for our study, which explores the impact of these reforms on companies' efforts to promote integrity and address climate change risks through enhanced CCDs.

### 3. Theoretical literature review

In examining the interplay between CG mechanisms and CCD, this study acknowledges several pertinent theoretical perspectives. According to agency theory (Jensen and Meckling, 2019), firms disclose information to bridge the gap between management and shareholders' goals. Stakeholder theory (Hamman *et al.*, 2010) emphasizes meeting the expectations of various stakeholders, whereas resourcebased theory highlights the role of governance in managing external relationships. Legitimacy Theory argues for the alignment of firm values with societal norms (Suchman, 1995). However, this study ultimately focuses on the neo-institutional theory, which delves into the impact of institutions on behavior through rules, norms and formal mechanisms (Ball and Craig, 2010; DiMaggio and Powell, 1983; Judge *et al.*, 2010; Kostova and Roth, 2002; Zattoni and Cuomo, 2008).

In examining the associations between CG mechanisms and CCDs, our analysis draws insights from neo-institutional theoretical perspectives, forming a dynamic, multidimensional socioeconomic framework. Neo-institutional theory posits that institutions have a profound impact on human behavior through rules, norms and formal or informal mechanisms (Ball and Craig, 2010; Judge *et al.*, 2010; Kostova and Roth, 2002).

DiMaggio and Powell (1983) identified three institutional pillars – coercive/regulative, normative and cognitive/mimetic pressures – within the neo-institutional framework to analyze their impact on firms. Our study argues that these interrelated institutional mechanisms, represented by CG, drive firms to engage in climate disclosure.

Formal regulations and guidelines, such as CGG, shape a firm's behavior by enforcing accepted standards. In the context of our study, coercive pressures emanate from regulatory bodies such as the BSEC, which introduced the CGC in 2018. This code outlines specific conditions and requirements, compelling firms to disclose their climate change initiatives to comply with the accepted standards (Karim *et al.*, 2021; Katmon *et al.*, 2019).

Firms assimilate social values and norms in alignment with conventions. In this study, normative pressure manifests as societal expectations for responsible and sustainable business practices. As environmental concerns gain global prominence, firms face

normative influences when disclosing their climate change actions. This expectation is reinforced through CG mechanisms such as board size and diversity, reflecting the evolving societal norms surrounding environmental responsibility (Hafsi and Turgut, 2013).

Arising from environmental ambiguity, firms emulate successful entities in their industries to gain institutional approval. In our study context, mimetic pressures materialize when firms observe their industry peers by adopting transparent climate-change disclosure practices. This prompts them to follow suit, incorporate foreign directors or establish audit committees to align with others' perceived successful and legitimate practices. (Khan *et al.*, 2019).

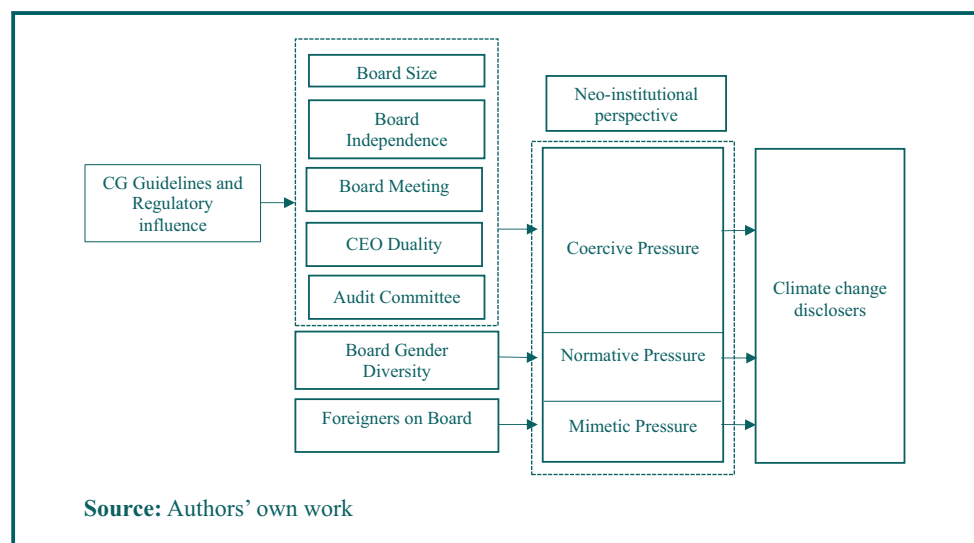
Figure 1 illustrates the relationship between CG mechanisms and CCDs through the coercive, normative and mimetic pressures used in this study.

Therefore, the application of neo-institutionalism in this study serves as a key predictor of the nuanced influence of board characteristics on climate disclosure (Aguilera *et al.*, 2007; Zattoni and Cuomo, 2008).

#### 4. Empirical literature review and hypothesis development

A considerable number of studies have examined the impact of CG on voluntary disclosures (Beekes and Brown, 2013; Collett and Hrasky, 2005) and corporate financial performance (Bozec and Bozec, 2012; Renders *et al.*, 2010), while non-financial performance measures are neglected (Alatawi *et al.*, 2023). Other studies have addressed various aspects, including common firm-level characteristics (Fifka, 2013) and social trust (Shahab *et al.*, 2023), to understand their effect on environmental disclosure performance, while limited research has investigated how board characteristics affect environmental disclosures (Lattemann *et al.*, 2009) by applying the lenses of institutional influence. However, an updated, good CG is associated with better monitoring and is expected to positively influence climate disclosure (Arora and Dharwadkar, 2011). Similarly, in the neo-institutional view, compliance with good governance rules, that is, coercive/regulative pressures on corporate structures and operations through increased climate disclosure practices, can improve the transparency of their business by boosting corporate reputation (Suchman, 1995). Similarly, increased dedication to imitating (i.e. cognitive/mimetic pressures) and/or adopting (i.e. normative pressures) CCD practices might increase

**Figure 1** Neo-institutional framework to see how regulatory pressure works through board characteristics on climate change disclosures





productivity by obtaining vital resources (i.e. funding, government contracts and qualified personnel) and winning over influential stakeholders (Ntim *et al.*, 2013). We draw from these strands of the literature to identify potential CG variables that might influence CCDs and develop a hypothesis for each of the board characteristics (board size, independent directors, foreign directors, board diversity, board meetings, CEO duality and audit committees).

#### *4.1 Effect of board size on climate change disclosures*

Board size is a crucial organ in the CG framework that influences board efficiency and effectiveness (Wang *et al.*, 2022; Al Amosh and Khatib, 2021 and Alnabsha *et al.*, 2018) by performing two main strategic functions: conformance (e.g. monitoring compliance with rules and disciplining managers) and performance (e.g. providing advice and access to resources) (Katmon *et al.*, 2019; Khan *et al.*, 2013 and Amran *et al.*, 2014). According to the neo-institutionalism postulate, an effective board structure with a larger board and distinct directors is associated with higher managerial monitoring, which improves shareholder efficiency by ensuring conformance to corporate regulations and norms (Katmon *et al.*, 2019; Ntim *et al.*, 2013). Thus, as CCD information is increasingly an important element of voluntary disclosures, we expect well-structured firms with larger boards to put more pressure on firms to commit to climate-friendly activities than their smaller counterparts (Karim *et al.*, 2021; Ntim *et al.*, 2013). Similarly, from a legitimation perspective, larger boards are linked to a more diverse range of expertise, experience and stakeholder representation that can enhance corporate reputation and image by setting a firm's sustainable agenda and allocating the necessary resources to disclose financial, social and climate information (Grecco *et al.*, 2013; Jizi, 2017; Ntim *et al.*, 2013).

In contrast, some argue that larger boards are ineffective because of coordination and communication problems (Jensen, 1993). That is, as the board gets larger, directors are inclined to give up their duties and participate in free-riding, which results in less managerial accountability (Ntim *et al.*, 2013). Therefore, larger boards are more likely to be controlled by powerful managers, which may have a detrimental effect on company disclosure practices.

Empirical evidence on the relationship between board size and CCD practices is generally rare and focuses on the context of developed countries. However, Ntim and Soobaroyen (2013) report that corporate boards have a positive impact on CCD disclosures, whereas García-Sánchez *et al.* (2015) find that corporate boards have an insignificant impact on CCD practices.

Given the conflicting literature, the impact of board size on CCD demands a more specific study of environmentally sensitive firms. This provides an opportunity to contribute to the existing literature. Therefore, we expect board size to positively affect CCD practice. Therefore, our hypotheses are as follows:

- H1.* There is a positive relationship between board size and the level of climate change disclosure.

#### *4.2 Effect of independent directors on climate change disclosures*

From a neo-institutional viewpoint, it can be observed that there is an inherent gap between managers and shareholders in modern companies, as ownership and control are intrinsically separated. Thus, the gap might cause mistrust and translate into a threat to management decisions supposedly taken in the best interests of shareholders (Ntim *et al.*, 2013). Therefore, the threat can be minimized by appointing independent directors who represent the board's degree of independence and stakeholders' expectations (Alkayed and Omar, 2022; Ntim *et al.*, 2013). Neo-institutional theory recommends that external



directors play a critical role in overseeing management activities by creating greater pressure on the board to adopt good climate policies and strategies that influence firms' image (Greenwood *et al.*, 2013; Karim *et al.*, 2021).

Existing empirical evidence largely suggests that the presence of independent directors positively affects CCD practices (Wang *et al.*, 2022). In line with prior research (Barako and Brown, 2008; Brammer and Pavelin, 2008; Eng and Mak, 2003), Lattemann *et al.* (2009) report the positive impact of independent directors on voluntary disclosures is reported by Lattemann *et al.* (2009). Furthermore, recent evidence by García-Sánchez and Martínez-Ferrero (2018), Cucari *et al.* (2018), Fernandes *et al.* (2019) and Ibrahim and Hanefah (2016) suggests that firms with a higher proportion of independent directors tend to be more socially responsible in both developed and emerging economies. In contrast, other studies have found a negative relationship between independent directors and CCD (Qa'dan and Suwaidan, 2019). For example, Alnabsha *et al.* (2018) found that the appointment of non-executive directors relies more on social networks and personal relationships than on personal qualities, negatively affecting CCD. However, a major hurdle in these studies is that they enforced CCD indirectly using the Raskins database or dummies, which raises the generalizability of the impact of these studies. Therefore, in this study, we use content analysis to measure the depth and degree of CCD in environmentally sensitive enterprises in Bangladesh. However, the Bangladesh CG guidelines recommend that at least one-fifth of board members be independent directors (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018). This institutional pressure implies an improvement in implementing climate-friendly activities, and we predict a positive, significant relationship between independent directors and CCD:

H2. There is a positive relationship between the number of independent directors and the level of climate change disclosure.

#### 4.3 Effect of foreign directors on climate change disclosures

Foreign directors have been at the forefront of encouraging the spread of effective codes of good CG, although they are normally a minority group on the board (Alkayed and Omar, 2022; Estelyi and Nisar, 2016). From a neo-institutional perspective, it can be observed that foreign directors act as catalysts to eliminate gaps by promoting transparency and accountability in voluntary disclosures (Khan *et al.*, 2019). They are also strongly committed to developing a national assortment of firms and foreign directors by enhancing CCD practices (Muttakin *et al.*, 2015). Therefore, foreign directors have a significant influence on companies' decisions on matters such as investments, executive appointments and disclosure (Oh *et al.*, 2011).

However, empirical evidence on the link between foreign directors and CCD practices is mixed. For instance, while Estelyi and Nisar (2016) documented that a board with a higher proportion of foreign directors is strongly significant to firm performance, Barako and Brown (2008) found that foreign directors have an insignificant effect on CCD. Moreover, Hahn and Lasfer (2016) and Katmon *et al.* (2019) indicate that foreign directors are associated with higher costs, ineffective monitoring and cross-cultural communication. In Bangladesh, the CG guidelines do not have any specific rules on foreign directors (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018), while firms incorporate foreign directors on the board and perceive mimetic pressure. Therefore, we expect that foreign directors will strive to gain the support of other influential parties, such as governments and employees, by lobbying managers to project a more socially responsible image. Therefore, we propose the following hypothesis:

H3. Foreign directors have a positive relationship with the level of climate change disclosure.

#### 4.4 Effect of gender diversity on climate change disclosures

Board gender diversity refers to a structure that includes various characteristics that may be present among board members who contribute information, skills and experiences that affect managerial efficiency and impact business decisions, specifically those pertaining to enterprise climate responsibility (Wang *et al.*, 2022; Cucari *et al.*, 2018; Hoang *et al.*, 2018; Nekhili *et al.*, 2018; Katmon *et al.*, 2019; Ntim *et al.*, 2013). Thus, diversity attributes may include those that are directly observable (gender, ethnicity, age and nationality) and those that are less visible (religion, education, occupation and culture); however, we consider the proportion of female directors in our current study (Haque, 2017). Neo-institutional theory recommends that boards of diverse gender backgrounds can help enhance shareholder efficiency by improving managerial monitoring, linking with stakeholders, attracting resources and maintaining CG (Ntim *et al.*, 2013). Additionally, corporate boards with female directors can exert more pressure on corporate managers to engage in increased environmental disclosure practices by developing creative ideas and opinions for board discussions (Harjoto *et al.*, 2015; Ntim *et al.*, 2013).

In line with this view, Carter *et al.* (2003) report that boards with more gender diversity in the US perform better than their counterparts. Similarly, Terjesen *et al.* (2009) reported that boards with distinctive female directors facilitate firms with a variety of resources, including financing. Moreover, female directors are more supportive and compassionate about social, ethical and climate disclosure (Hafsi and Turgut, 2013; Isidro and Sobral, 2014). However, contemporary literature shows a mixed effect of gender diversity on decision-making and CCD practices, including a positive association (Liao *et al.*, 2015; Lu and Herremans, 2019) and negative or limited effects (Al Kurdi *et al.*, 2023; Cucari *et al.*, 2018). Nevertheless, the Bangladesh guidelines do not specify the minimum required number of female directors (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018); and we expect that more diverse boards tend to put more pressure on corporate managers to engage in increased CCD practices. Thus, we propose the following hypotheses:

- H4. There is a positive relationship between gender diversity and the level of environmental change disclosure.

#### 4.5 Effect of board meetings on climate change disclosures

Scholarly literature indicates that the level of pursuit and diligence of board members is often explained by the number of meetings (Al Amosh and Khatib, 2021; Alnabsha *et al.*, 2018). According to the neo-institutionalism postulates, normative pressure drives firms to have frequent meetings to deal with increased competition, operational complexity and uncertainty that help address different stakeholders' concerns and better gauge firms' various risks, including those relating to climate challenges. However, the nature of the interconnection between board meetings and CCD practices seems complex, because scholars are divided into different views. Some scholars argue that more frequent meetings positively affect board efficiency, better supervision and organizational transparency, which also work well during any crisis and uncertainty, and that frequent board meetings may pacify shareholders' expectations and refine the company's performance (Al Amosh and Khatib, 2021; Karim *et al.*, 2021). In contrast, more frequent board meetings imply an inactive and futile board that is invasive to the CCD (Frias-Aceituno *et al.*, 2013). However, other studies have reported no association between the frequency of board meetings and CCD (Wang *et al.*, 2022; Yusoff *et al.*, 2019; Hussain *et al.*, 2018). In Bangladesh, the importance of board meetings can also be found in the CG guidelines (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018). Therefore, we assume there is a need for frequent board meetings to oversee the integration of a board regarding CCD, and propose the following hypothesis:

- H5. There is a positive relationship between the number of board meetings and the level of climate change disclosure.

#### *4.6 Effect of CEO duality on climate change disclosures*

CEO duality occurs when a firm engages the same person as its Chairman of the Board, Managing Director and/or Chief Executive Officer, which tends to lead to a centralization of power, compromising governance, contrasting board independence and creating self-utility-maximizing attitudes over the decision-making process (Dalton and Dalton, 2005). Theoretically, neo-institutionalism postulates that the chairperson of the board is a crucial person who monitors the activities of top management, such as the CEO (Greenwood *et al.*, 2013). Moreover, when the same person includes the chairperson of the board and the CEO, the effectiveness of the board in monitoring top management is dwindled because of the dominant power of the chairperson, which negatively correlates with a firm's ability to monitor quality, accountability and sustainability practices (Hussain *et al.*, 2018). Therefore, it is recommended that a different individual fill in the positions of the Chairperson of the Board and the MD and/or CEO (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018). Interestingly, few existing studies indicate opposite views, arguing that the separation may not be urgent, as many firms are successful with the same person as the Chairperson and CEO (Wang *et al.*, 2022). However, most studies find that the dual position offers indomitable power to one person, which may compromise the environment. This debate calls for further testing to identify the relationship between CEO duality and CCD. Thus, we propose the following hypotheses:

- H6. There is a negative relationship between CEO duality and the level of climate change disclosure.

#### *4.7 Effect of audit committee on the climate change disclosures*

Prior studies have recognized the significance of effective audit committees in the oversight of the financial reporting process (Alkayed and Omar, 2022; Al-Shaer and Zaman, 2018). The purpose of an audit committee is to protect against any questionable reporting decisions made by management (Zaman *et al.*, 2011). The audit committee is associated with financial affairs, but it can provide additional oversight of CCD practices. The existence of an audit committee may ensure accountability from management and exercise greater control over them through appropriate governance (Abbott *et al.*, 2016). According to neo-institutional theory (Greenwood *et al.*, 2013), an audit committee is composed of executive and non-executive members with expertise in accounting and finance that protects firms' financial asymmetry and urges them to report CCD. This is mandatory in the Bangladesh CG guidelines (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018). However, the effect of the audit committee in connection with CCD has not been documented in many studies (Saha *et al.*, 2019). Thus, from a neo-institutional perspective, firms accept coercive pressure from institutions to form audit committees.

However, the empirical evidence on the link between audit committees and CCD practices is mixed. For instance, Alkayed and Omar (2022) have demonstrated a typically favorable connection between the audit committee and CCD, while Al Kurdi *et al.* (2023) and Saha and Akter (2013) have revealed a negative relationship between audit committees and CCD. Therefore, an audit committee is mandatory in the CGC of Bangladesh (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018). Overall, previous research and promulgated policies recommend that the audit committee is likely to be responsible for CCD practices, in addition to the existing role of monitoring financial information. Therefore, we propose the following hypotheses:

- H7. There is a positive relationship between the presence of an audit committee and the level of climate change disclosure.

## 5. Research design

### 5.1 Sample and data

We concentrated on all manufacturing companies listed on the Dhaka Stock Exchange (DSE) in Bangladesh, focusing on the years 2014–2021, as they are deemed most responsible for climate degradation. Financial institutions are excluded because of their unique accounting needs, different governance systems and legal environments (Luo and Tang, 2021; Orazalin, 2020). The sample was further filtered to retain firms with the required data for the entire eight-year period, aligning with previous research standards (Baboukardos, Mangena and Ishola, 2021). The timespan was divided into two categories: pre-amendment of CG from 2014 to 2017 and post-amendment of CG from 2018 to 2021 (see Panel A of Table 1).

Panel B of Table 1 outlines the sample selection process to represent environmentally sensitive firms that are most exposed to climate regulations, guidelines and public pressure (Al-Shaer and Zaman, 2019). This yielded 800 firm-year observations from 100 firms, representing eight sectors listed in the DSE. Data on internal CG mechanisms and climate disclosures were obtained from published annual reports that provide comprehensive, objective and systematic information on publicly listed companies in Bangladesh (Haque, 2017; Orazalin, 2020). According to earlier investigations, environmentally sensitive firms are more likely to disclose their climate actions to address regulatory threats by managing coercive pressures (Datt et al., 2019).

Panel C in Table 1 presents the sample distribution by sector. Engineering, with 224 observations (28%), was the most represented sector, followed by textiles with 160 observations (20%), pharmaceuticals and chemicals with 152 observations (19%) and fuel and power with 144 observations (18%).

**Table 1** Time period and sample selection

*Panel A: Time period*

Period	Financial years	Period in relation to the CG
Period 1	2014–2017	Pre-amendment of CG
Period 2	2018–2021	Post-amendment of CG

*Panel B: Sample selection process*

	Firms	No. of observations	% <sup>†</sup>
All firms and observations	167	1,336	100
Less: firms and observations with insufficient data	67	536	40
Final sample	100	800	60

*Panel C: Sample distribution by sector*

Industries	Population <sup>†</sup>			Sample <sup>†</sup>			Sample to population percentage <sup>†</sup>
	Firms	Obs.	%	Firms	Obs.	%	
Cement	7	56	4	7	56	7	100
Ceramic	5	40	3	3	24	3	60
Engineering	39	312	23	28	224	28	72
Fuel and power	19	152	11	18	144	18	95
Jute	3	24	2	2	16	2	67
Pharmaceuticals and chemicals	32	256	19	19	152	19	59
Tannery	6	48	4	3	24	3	50
Textile	56	448	34	20	160	20	36
Total	167	1,336	100	100	800	100	60

Note: <sup>†</sup>% is rounded up

Source: Authors' own work

The sample provides a unique setting for investigation because of the introduction of national CG guidelines during the study period and the selection of environmentally sensitive industries that allow examining the extent of CCDs in response to policy guidance and regulations.

Content analysis, following [Cui et al. \(2020\)](#), was applied, involving a careful reading of various sections of annual reports, including CCDs, CG disclosures, directors' reports, chairman's statements and notes to the financial statements ([Larrán Jorge et al., 2018](#); [Saha, 2019](#)), to capture CCD. Annual reports are considered the most reliable source of CCD information and are essential for communicating organizational information to stakeholders ([Saha et al., 2020](#)). Especially in this instance, annual reports were downloaded from the firm's website and verified where necessary ([Saha et al., 2019](#)).

## 5.2 Variable definition

[Table 2](#) presents the variables used to test the research hypotheses. CCDs were quantified using content analysis ([Ntim et al., 2013](#)). Two independent coders initially coded CCD for the sample of firms. Any confusion during coding was resolved through discussions between independent coders, and cross-checks were performed to identify duplications and eliminate inconsistencies. Subsequent scrutiny by a coder revealed no discrepancies, thus confirming the validity and reliability of the coding process.

We focus on the Global Reporting Initiative (GRI) framework to determine 12 disclosure items, aligned with [Clarkson et al. \(2008\)](#) and GRI guidelines ([GRI, 2021](#)). The 12 dimensions outlined in [Appendix A](#) include disclosures about waste management, renewable energy, energy efficiency, climate and carbon management policy, awards for climate initiatives, a separate department for corporate social responsibility and climate management, green policy and enactment, tree plantations, climate education and training programs and global warming ([Khan et al., 2013](#); [Saha and Akter, 2013](#)).

Firms are assigned a score of one if an item from our checklist is disclosed in the annual report; otherwise, they receive a score of zero. Consequently, the CCD index was calculated by determining the ratio of the actual scores allocated to each firm's maximum score (12).

**Table 2** Definition and measurement of variables

Variables	Symbols	Variable types	Operationalization
Climate change disclosure	CCD	Dependent	Total disclosure score. Here, climate change disclosure is calculated on 1 or 0 scales [1 = if an item from our checklist is disclosed in the annual report, else 0]
Board size	BSIZE	Independent	Natural log of the total number of directors on the board of a company
Board independence	INDIR	Independent	The percentage of independent directors on the board
Foreigners on board	FORDIR	Independent	The percentage of foreign directors on the board
Board gender diversity	GENDER	Independent	Percentage of male and female to the total number of directors on the board of a company
Board meeting	BOMEET	Independent	Natural log of the number of board meetings held in a year
CEO duality	DUALITY	Independent	The same person holds the positions of chairman and CEO in a firm. Here, duality is calculated on 1 or 0 scales [1= if the same person holds both positions, else 0]
Audit committee	ADCOM	Independent	Natural log of the number of audit committee members
Firm size	SIZE	Control	Natural log of net asset value per share
Profitability	ROA	Control	Earnings before interest and taxes/total assets
Leverage	LEV	Control	Total debt divided by total assets
Industry	INDUS	Control	Industry belongingness. Dummy variable
Year	YEAR	Control	Sample year. Dummy variable

Source: Authors' own work

### 5.3 Model specification

The models were developed to investigate the association between the CG nexus and climate disclosures. First, we suggest our initial model (1), in which we regress the seven CG mechanisms (board size, board independence, foreigners on board, board diversity, board meetings, CEO duality and audit committee), as well as the control variables on CCDs. Therefore, we apply model (1) to examine our proposed research *hypotheses H1–H7*:

$$\begin{aligned} \text{CCD}_{i,t} = & \beta_0 + \beta_1 \text{BSIZE}_{i,t} + \beta_2 \text{INDIR}_{i,t} + \beta_3 \text{FORDIR}_{i,t} + \beta_4 \text{GENDER}_{i,t} + \beta_5 \text{BOMEET}_{i,t} \\ & + \beta_6 \text{DUALITY}_{i,t} + \beta_7 \text{ADCOM}_{i,t} + \sum \text{Controls} + \sum \text{Year} + \sum \text{Industry} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

[...] where  $i$  and  $t$  stand for the firm and the time period, respectively;  $\beta_0$  = intercept;  $\beta_1$  and  $\beta_7$  = coefficient of slope parameters; and  $\varepsilon$  = error term. CCD indicates whether a firm discloses climate change information. In earlier studies, this metric was commonly applied (Simnett *et al.*, 2009). All the variables are defined and measured in Table 2.

## 6. Results

### 6.1 Descriptive analysis

Table 3 presents detailed descriptive statistics related to the sample firms' CCD, board matrix and control variables. According to Panel A of Table 3, the average value of CCD during pre-amended CG and post-amended CG is 45.62% and 46%, respectively, with a minimum value of 0% and a maximum value of 100%, which is higher than that of the previous study (Muttakin *et al.*, 2015) and denoting CCD has slightly increased over time. Moreover, in the pre-amended period, the average board size is 7.71, ranging from a minimum of 5 to 20, indicating that the board of directors is mostly in line with CG guidelines (Securities and Exchange Commission,

**Table 3** Descriptive statistics

	Entire period				Pre-amendment of CG				Post-amendment of CG			
Variable names	Min.	Max	Mean	SD	Min.	Max	Mean	SD	Min.	Max	Mean	SD
Panel A: Variable-wise descriptive statistics												
CCD	0	100	45.62	27.44	0	100	45.62	27.00	0	100	46	27.74
BSIZE	4	20	7.72	2.71	5	20	7.71	2.73	4	19	7.73	2.68
INDIR	0	50	25.41	6.77	0	50	25.00	6.10	11	50	25.75	7.18
FORDIR	0	70	5.92	16.53	0	70	6.10	16.77	0	70	5.74	16.30
GENDER	0	67	15.57	15.52	0	67	15.52	15.46	0	57	15.62	15.60
BOMEET	4	30	8.72	4.71	4	30	8.73	4.75	4	23	8.71	4.67
DUALITY	0	1	0.01	0.10	0	1	0.01	0.10	0	1	0.01	0.10
ADCOM	2	7	3.80	0.83	2	7	3.81	0.88	3	6	3.78	0.78
SIZE	0.15	508	58.58	66.70	4.3	508	57	68	0.15	395	59	65
ROA	−4.1	11.45	0.1	0.53	−0.16	11.45	0.14	0.71	−4	0.8	0.05	0.23
LEV	0	11.86	0.29	0.78	0	11.86	0.33	1.02	0	4.5	0.24	0.4
Panel B: Industry-wise descriptive statistics												
Industries	Observations				Minimum				Maximum			
Cement	49				0.42				0.92			
Ceramic	21				0.25				0.83			
Engineering	196				0				0.92			
Fuel and power	126				0.08				1			
Jute	14				0.08				0.08			
Pharmaceuticals and chemicals	133				0.08				0.92			
Tannery	21				0.50				1			
Textile	140				0.83				0.92			

**Note:** See Table 2 for variable definitions. The sample includes 800 firm-year observations

**Source:** Authors' own work



2012; Bangladesh Securities and Exchange Commission, 2018), while in the post-amended period, the average board size is 7.71, with a minimum of 4 to a maximum of 19, which is inconsistent with CG (Bangladesh Securities and Exchange Commission, 2018). Additionally, companies nominate independent directors at a rate ranging from 0% to 50%, with an average of 25% during the pre-amended period and a greater rate during the post-amended period. This is also consistent with CG guidelines, where the minimum number of independent directors is 20% of the total board members (Bangladesh Securities and Exchange Commission, 2018). In addition, during the pre-amended period and post-amended period, firms constitute audit committees with an average size of 3.81 and 3.78, respectively, comparable with the average of 3.24 in the existing international literature (Katmon *et al.*, 2019), which mostly fulfill the Bangladesh CG guidelines of at least three members (Bangladesh Securities and Exchange Commission, 2018). Even though CG rules do not specify minimum standards for the number or proportion of female directors, pre-amended period and post-amended period enterprises, respectively, had an average of 15.52% and 15.62 female directors, respectively, which is higher than the existing international literature of 7% (Terjesen *et al.*, 2009). Similarly, in the pre-amended period, firms covered an average of 6.10% foreign directors and 5.74% in the pre-amended period, which is also higher than international evidence (Katmon *et al.*, 2019). In addition, in the pre-amended and post-amended periods, firms follow the provision of board meetings, where the average number of board meetings is very close, 8.73–8.71, respectively. Additionally, the findings demonstrate that businesses adhere to the CG rule on duality, where the average value is 0.01 and recommends distinct people for the roles of managing director, chief executive officer and chairman of the board.

Panel B of Table 3 describes the CCD of different industries, where the highest disclosure is reported by tannery 0.78 (i.e. 78%), followed by cement 0.62 (i.e. 62%), ceramic 0.58 (i.e. 58%) and pharmaceuticals and chemicals 0.54 (i.e. 54%); in contrast, jute reports the lowest value of 0.083 (8.3%). In addition, on average, the CCD of remaining industries is as follows: fuel and power 0.46 (i.e. 46%), engineering 0.42 (i.e. 42%) and textiles 0.31 (i.e. 31%).

Table 4 shows the Pearson correlations and variance inflation factors (VIFs) of the independent variables. The correlation coefficients implied no severe multicollinearity issues (Tabachnick and Fidell, 2001). The VIF results confirm the absence of multicollinearity, as the VIF scores are below two (Neter *et al.*, 1985). The results show that all variables appear to fit the regression analysis.

## 6.2 Multivariate regression results

Tables 5–7 present the outcomes of the analysis exploring the impact of various board characteristics on CCD for distinct periods: 2014–2017 (pre-amendment), 2018–2021 (post-amendment) and 2014–2021 (entire period). Using regression models, this study assessed

**Table 4** Correlations and variance inflation factor (VIF)

Independent variables	VIF	BSIZE	INDIR	FORDIR	GENDER	BOMEET	DUALITY	ADCOM	SIZE	ROA	LEV
BSIZE	1.11	1.00									
INDIR	1.18	−0.23***	1.00								
FORDIR	1.21	−0.02	0.25***	1.00							
GENDER	1.06	−0.15***	−0.01	−0.11***	1.00						
BOMEET	1.04	0.04	0.01***	−0.05	−0.05*	1.00					
DUALITY	1.02	−0.02	0.05	−0.03	0.08**	0.00	1.00				
ADCOM	1.16	0.08**	−0.6*	0.28***	0.00	0.00	−0.09**	1.00			
SIZE	1.05	0.03	0.07*	0.07*	0.04	−0.08*	−0.01	−0.12***	1.00		
ROA	1.02	0.00	−0.00	0.04	−0.03	0.03	−0.01	0.08**	0.00	1.00	
LEV	1.03	0.08**	−0.01**	−0.02	0.00	0.09	−0.01	0.05*	−0.02	0.08**	1.00

Notes: \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See Table 2 for variable definitions

Source: Authors' own work



**Table 5** Influence of board characteristics on climate change disclosure practices during the pre-amendment period of 2014–2017

Dep. variable Model	CCD (1)	CCD (2)	CCD (3)	CCD (4)	CCD (5)	CCD (6)	CCD (7)	CCD (8)
Independent variables (CG matrix)								
BSIZE	1.6***							1.56***
INDIR		0.19						0.22
FORDIR			0.44***					0.34***
GENDER				−0.13				0.02
BOMEET					−0.16			−0.12
DUALITY						−0.27**		−0.22*
ADCOM							7.4***	4.7***
Control variables								
SIZE	Y	Y	Y	Y	Y	Y	Y	0.02*
ROA	Y	Y	Y	Y	Y	Y	Y	2.8
LEV	Y	Y	Y	Y	Y	Y	Y	−1.6
Year-fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Industry effect	Y	Y	Y	Y	Y	Y	Y	Y
No of firm year obs.	800	Y800	Y800	Y800	800	800	800	800
R <sup>2</sup>	0.04	0.01	0.09	0.02	0.02	0.02	0.07	0.016

Notes: \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See Table 2 for variable definitions

Source: Authors' own work

the effects of individual and collective board attributes on the CCD of environmentally sensitive firms. Specifically, Models 1–7 delineate the influence of specific board attributes on CCD, whereas Model 8 encapsulates the cumulative impact of all board variables

In the pre-amendment period of CG, Models 1 and 8 in Table 5 reveal a noteworthy positive association between board size (BSIZE) and CCD. This positive correlation persisted in the post-amendment period, as indicated in Table 6, and was consistent across the entire period (Table 7), supporting the empirical validation of *H1*.

**Table 6** Influence of board characteristics on climate change disclosure practices during the post-amendment period of 2018–2021

Dep. variable Model	CCD (1)	CCD (2)	CCD (3)	CCD (4)	CCD (5)	CCD (6)	CCD (7)	CCD (8)
Independent variables (CG matrix)								
BSIZE	1.45**							1.76***
INDIR		0.27						0.27
FORDIR			0.45***					0.39***
GENDER				−0.45				−0.01
BOMEET					−0.1			−0.48*
DUALITY						−0.28**		−23*
ADCOM							5.7***	2.92*
Control variables								
SIZE	Y	Y	Y	Y	Y	Y	Y	0.01*
ROA	Y	Y	Y	Y	Y	Y	Y	17**
LEV	Y	Y	Y	Y	Y	Y	Y	−3.16
Year-fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Industry effect	Y	Y	Y	Y	Y	Y	Y	Y
No of firm year obs.	800	800	800	800	800	800	800	800
R <sup>2</sup>	0.07	0.06	0.13	0.05	0.06	0.06	0.08	0.02

Notes: \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See Table 2 for variable definitions

Source: Authors' own work

**Table 7** Influence of board characteristics on climate change disclosure practices during the entire period of 2014–2021

Dep. variable Model	CCD (1)	CCD (2)	CCD (3)	CCD (4)	CCD (5)	CCD (6)	CCD (7)	CCD (8)
Independent variables (CG matrix)								
BSIZE	1.58***							1.7***
INDIR		0.28**						0.28**
FORDIR			0.46***					0.37***
GENDER				−0.12**				0.00
BOMEET					−0.30			−0.31
DUALITY						−0.28**		−0.22**
ADCOM							6.72***	3.9***
Control variables								
SIZE	Y	Y	Y	Y	Y	Y	Y	0.02*
ROA	Y	Y	Y	Y	Y	Y	Y	4.3**
LEV	Y	Y	Y	Y	Y	Y	Y	−1.9
Year-fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Industry effect	Y	Y	Y	Y	Y	Y	Y	Y
No of firm year obs.	800	800	800	800	800	800	800	800
R <sup>2</sup>	0.01	0.02	0.01	0.02	0.02	0.03	0.06	0.016

Notes: \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See [Table 2](#) for variable definitions

Source: Authors' own work

Conversely, Models 2 and 8 do not yield substantial evidence of a connection between independent directors and CCD in the pre- and post-amendment CG periods. However, [Table 7](#) reveals a robust association, partially affirming *H2*.

In the pre- and post-amendment periods, Models 3 and 8 exhibit a significant positive correlation between foreign directors and CCD. This positive relationship endures across the entire period, reinforcing *H3*.

Examining the impact of gender diversity on CCD in Models 4 and 8, the findings suggest a minor influence during both pre- and post-CG amendment periods. However, Model 4 in [Table 7](#) presents a negative association between gender diversity and CCD, consistent with previous research ([Al Kurdi et al., 2023](#)).

Models 5 and 8 reveal an insignificant negative relationship between the frequency of board meetings and CCD, contradicting *H5*. This finding challenges the theoretical notion that frequent board meetings provide an optimal platform to address climate-related concerns.

For CEO duality, Models 6 and 8 demonstrate a negatively significant impact on CCD during both the pre- and post-amendment periods, supporting *H6*. This aligns with the existing literature, emphasizing the potential conflict of interest when the roles of Chairman and CEO are held by the same individual.

Finally, Models 7 and 8 highlight a highly significant positive relationship between the audit committee and CCD during both the pre- and post-amendment periods, strongly corroborating *H7*.

In summary, the study identifies board size, foreign director presence and the audit committee as significant positive factors influencing CCD, supporting the respective hypotheses. Conversely, CEO duality has a negative impact on CCD. The analysis did not reveal robust connections between CCD and independent directors, female directors or board meetings. Additionally, no significant changes were observed in the pre- and post-amendment periods of CG. Neo-institutional theory provides a theoretical framework for comprehending the varied influences that shape firm survival through governance and accountability in disclosures.

### 6.3. Robustness tests

Several robustness checks were conducted to ensure the consistency and stability of our results.

**6.3.1 Alternative definition of climate change disclosure.** As part of a robustness check, we sought to replicate our initial findings presented in Table 7 by substituting the quantitative measure (CCD index) with its alternative (CCD word count) (Ntim *et al.*, 2013). The detailed results of this analysis are listed in Table 8. Importantly, the results in Table 8 confirm the original findings. This consistency not only emphasizes the resilience of our data set, but also highlights the stability of our conclusions, demonstrating that our findings hold true whether using a qualitative measure (disclosure indices) or a quantitative measure (word counts) to assess CCD practices. This robustness check replicates our original study results by adding an extra layer of confidence to the reliability and validity of our findings.

**6.3.2 Lagged climate change disclosure.** We posit that the impact of regulatory influence may unfold gradually, with changes manifesting over time. To explore this temporal dynamic, we re-estimated Models 1–3 by incorporating a lagged dependent variable, CCD. It is noteworthy that these lagged variable results essentially replicate our original findings, reinforcing the robustness and consistency of the observed relationships. Confirming the positive and significant impact of board size, independent directors, foreign directors and audit committees on CCD, Table 9 presents the results. Conversely, CEO duality exhibits a negative and significant association with CCD, suggesting that the separation of Chairman and CEO roles positively influences CCDs. The nuanced relationship between board meetings and CCD implies a potential trade-off between meeting frequency and disclosure practice. These findings underscore the enduring influence of CG factors on climate-related disclosures across different periods.

**6.3.3 Industry-fixed effect.** Considering the longitudinal nature of our data set and our objective to delve into the nuanced connection between CG and climate change disclosure (CCD), we extend our analysis using industry fixed-effects regression, as detailed in Table 10. In concordance with our primary findings, this supplementary analysis reaffirms the statistical significance of board size, foreign directors and the audit committee concerning CCD in Models 1, 2 and 3. However, this robustness check indicates a lack of significant influence from independent directors, gender diversity and board meetings on

**Table 8** Influence of board characteristics on climate change disclosure practices based on word count

Dep. variable Model	CCDW (1)	CCDW (2)	CCDW (3)	CCDW (4)	CCDW (5)	CCDW (6)	CCDW (7)	CCDW (8)
Independent variables (CG matrix)								
BSIZE	1.13**							0.906***
INDIR		−0.131						−0.083
FORDIR			0.255***					0.195***
GENDER				−0.043				0.030
BOMEET					−0.194			−0.150
DUALITY						−20***		−16.207***
ADCOM							5.28***	3.775***
Control variables								
SIZE	Y	Y	Y	Y	Y	Y	Y	Y
ROA	Y	Y	Y	Y	Y	Y	Y	Y
LEV	Y	Y	Y	Y	Y	Y	Y	Y
Year-fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Industry effect	Y	Y	Y	Y	Y	Y	Y	Y
No of firm year obs.	800	800	800	800	800	800	800	800
R <sup>2</sup>	19.396	19.573	19.183	19.58	19.571	19.491	19.105	18.732

Notes: \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See Table 2 for variable definitions

Source: Authors' own work

**Table 9** Lagged effect results on the relationship between CG and CCD

<i>Sample period</i> <i>Variable name</i> <i>Models</i>	<i>Entire period</i> <i>Coefficient</i> <i>(1)</i>	<i>Pre-amendment</i> <i>Coefficient</i> <i>(2)</i>	<i>Post-amendment</i> <i>Coefficient</i> <i>(3)</i>
BSIZE	1.71***	1.567**	1.757***
INDIR	0.25*	0.201	0.248
FORDIR	0.372***	0.337***	0.394***
GENDER	0.003	0.028	−0.007
BOMEET	−0.321	−0.129	−0.492*
DUALITY	−22.743**	−21.856*	−22.939*
ADCOM	4.079**	4.933**	3.113*
SIZE	0.023*	0.028	0.016
ROA	4.285**	2.845	17.928**
LEV	−1.956*	−1.721	−3.418
YEAR	Y	Y	Y
INDUSTRY	Y	Y	Y
R <sup>2</sup>	0.134	0.121	0.145

**Notes:** \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See [Table 2](#) for variable definitions

**Source:** Authors' own work

CCD. Notably, CEO duality exhibited a negative and significant association with CCD in Model 2. This supplementary analysis supports and reinforces our original findings, providing additional evidence of consistent relationships identified across diverse analytical approaches.

*6.3.4 Endogeneity, Instrumental variable and two-stage least squares regression.* Acknowledging the potential interactions among CG factors, as suggested by prior research ([Khan et al., 2019](#)), we recognize that firms strategically appoint boards or subcommittee members to align with their corporate culture. In line with the methodology proposed by [Larcker and Rusticus \(2010\)](#), we systematically address concerns related to potential endogeneity by using the two-stage least squares (2SLS) method, as detailed in [Table 11](#). Given the interconnected nature of CG factors, particularly the appointment of board or subcommittee members, we adopted the strategy outlined by [Cho and Kim \(2003\)](#). In this regard, we treat the number of independent directors as an endogenous variable that is influenced by company board size. This approach accounts for the

**Table 10** Fixed effect results on the relationship between CG and CCD

<i>Sample period</i> <i>Variable name</i> <i>Models</i>	<i>Entire period</i> <i>Coefficient</i> <i>(1)</i>	<i>Pre-amendment</i> <i>Coefficient</i> <i>(2)</i>	<i>Post-amendment</i> <i>Coefficient</i> <i>(3)</i>
BSIZE	1.394***	1.13**	1.544**
INDIR	−0.104	−0.168	−0.131
FORDIR	0.247***	0.20**	0.271**
GENDER	0.029	0.042	0.016
BOMEET	−0.193	−0.041	−0.322
DUALITY	−21.969	−21.79*	−20.630
ADCOM	4.588***	5.316***	3.935**
SIZE	0.005	0.022	−0.014
ROA	3.661**	2.277	17.430**
LEV	−2.043*	−0.195*	−2.617*
YEAR	Y	Y	Y
INDUSTRY	Y	Y	Y
R <sup>2</sup>	0.127	0.127	0.142

**Notes:** \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See [Table 2](#) for variable definitions

**Source:** Authors' own work

**Table 11** 2SLS regression results on the relationship between CG and CCD

Sample period Variable name Models	Entire period Coefficient (1)	Pre-amendment Coefficient (2)	Post-amendment Coefficient (3)
BSIZE	−0.758	0.035	−0.768
FORDIR	0.369***	0.337***	0.384***
GENDER	−0.004	0.042	−0.027
BOMEET	−0.177	−0.054	−0.290
DUALITY	−26.812**	−26.462**	−26.143**
ADCOM	4.60***	5.249***	3.623**
SIZE	0.035**	0.040**	0.027
ROA	3.848**	2.325	19.049**
LEV	−2.273*	−2.162*	−4.316
YEAR	0.327	0.496	−0.266
INDUSTRY	−2.134	−2.502	−1.539**
R <sup>2</sup>	11.98	15.98	12.72
Durbin–Wu–Hausman	2.498	0.180	1.574

Notes: \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively. See Table 2 for variable definitions

Source: Authors' own work

regulatory requirement that boards maintain at least 20% of independent directors to comply with CG rules, as stipulated by the [Securities and Exchange Commission \(2012\)](#) and the [Bangladesh Securities and Exchange Commission \(2018\)](#). The 2SLS results in Table 11 offer insights into potential endogeneity concerns and contribute to the validity and reliability of our findings.

The Durbin–Wu–Hausman statistics falling within 1.5 and 2.5 signify the acceptability of our model ([Ullah et al., 2018](#)).

#### 6.4 Additional test to see the impact of the corporate governance code amendment

We conducted additional tests to assess statistical differences using both the parametric *t*-test and the nonparametric Wilcoxon rank test, as presented in Table 12 ([Saha and Khan, 2024](#)). In line with our research propositions and main findings, the parametric *t*-test revealed that board size and independent directors were statistically positively significant, whereas foreign directors and board meetings were negatively significant with respect to CCD. Similarly, the Wilcoxon rank test indicates that board size, independent directors, board meetings and audit committees are positively significant, while foreign directors and

**Table 12** Difference in pre- and post-amendment of CG guideline

Variables	Mean difference	t-Test	Wilcoxon rank test
CCD	1.21	0.58	0.55
BSIZE	37	2.38**	3.04**
INDIR	8.98	2.52**	13***
FORDIR	−16	−5.34*	−26***
GENDER	3	1.40	−22
BOMEET	−18	−5.6***	14***
DUALITY	−4.50	0	−26***
ADCOM	3.57	0.34	4.9***

Notes: The table presents differences in means, t-test and Wilcoxon rank-sum test results for the explanatory variables; \*, \*\* and \*\*\* indicate significance at 10, 5 and 1% levels of confidence, respectively; See Table 2 for variable definitions

Source: Authors' own work

CEO duality are negatively significant concerning CCD. Interestingly, no significant relationship between female directors and CCD was observed, which is consistent with our earlier findings.

## 7. Discussion

In the discussion section, we delve into the key findings of our study by examining the relationships between various board characteristics and CCD.

*H1:* The study consistently reveals a significant and positive relationship between board size and CCD across all examined periods – pre-amendment, post-amendment and the entire period. This finding strongly supports *H1*, indicating that companies with larger boards tend to disclose more information on climate change. This aligns with theoretical predictions and prior studies (Al Kurdi *et al.*, 2023; Nguyen *et al.*, 2021; Post *et al.*, 2015; Zou *et al.*, 2019). Larger boards, integral to CG, enhance efficiency and effectiveness by facilitating managerial monitoring and compliance with regulations (Wang *et al.*, 2022; Al Amosh and Khatib, 2021; Alnabsha *et al.*, 2018). From a neo-institutionalism perspective, well-structured firms with larger boards are likely to push for climate-friendly activities, emphasizing CCD in voluntary disclosure (Grecco *et al.*, 2013; Jizi, 2017; Ntim *et al.*, 2013).

However, contrasting views propose potential coordination issues and free-riding on larger boards, raising concerns about reduced managerial accountability (Jensen, 1993; Ntim *et al.*, 2013). Despite the conflicting literature, our study, focusing on environmentally sensitive firms, supports the positive impact of board size on CCD practices. This finding highlights the unique context of environmentally sensitive firms and their commitment to CCD.

*H2:* Second, our findings for the entire sample show that independent directors are significant to CCD, indicating that *H2* is supported and in line with the existing empirical literature (Fernandes *et al.*, 2019 and Ibrahim and Hanefah, 2016). However, we find no significant relationship between independent directors and CCD throughout the pre- and post-amendment periods. Theoretically, the appointment of independent directors represents a board's degree of independence relative to the interests of various stakeholders (Alkayed and Omar, 2022). The appointment of independent directors is seen as a means of mitigating the inherent mistrust arising from the separation of ownership and control, thereby aligning management decisions with shareholder interests (Alkayed and Omar, 2022; Ntim *et al.*, 2013). Because this is a regulatory requirement, independent directors may be more motivated to put pressure on managers to engage in good CCD practices.

Regarding the regulatory impact of independent directors, a stronger association emerged in the analysis covering the entire period (Fernandes *et al.*, 2019; Ibrahim and Hanefah, 2016). However, no credible evidence of a relationship was found in the pre- and post-amendment periods. The mixed findings suggest that the role of independent directors in influencing CCD may be context specific. The lack of authority of independent directors to force climate disclosures might contribute to the inconsistency observed, as highlighted in the literature.

*H3:* The empirical findings confirm the presence of a significant positive relationship between foreign directors and CCD, thereby substantiating *H3*. This alignment with the theoretical perspective underscores the pivotal role of foreign directors as catalysts in promoting transparency and accountability in voluntary disclosures (Khan *et al.*, 2019). Their influential contributions extend to shaping critical company decisions, spanning investments, executive appointments and the disclosure of climate-related information (Oh *et al.*, 2011).

This study contributes to the broader discourse on the relationship between foreign directors and CCD practices by offering nuanced insights (Estelyi and Nisar, 2016; Khan *et al.*, 2019; Muttakin *et al.*, 2015; Oh *et al.*, 2011). While some studies, such as Estelyi and Nisar (2016), emphasize the significant positive impact of foreign directors on firm performance, others, such as Barako and Brown (2008), report an insignificant effect on CCD. Moreover, concerns raised by Hahn and Lasfer (2016) and Katmon *et al.* (2019) regarding potential challenges, such as higher costs, ineffective monitoring and cross-cultural communication associated with foreign directors, contribute to the complexity of understanding this relationship.

Within the context of Bangladesh, where CG guidelines lack specific provisions regarding foreign directors, their inclusion on boards is predominantly driven by mimetic pressure. This study suggests that foreign directors actively engage in lobbying efforts to gain support from influential parties, such as governments and employees, aiming to project a more socially responsible image. This finding illuminates the nuanced role of foreign directors in influencing CCD practices, particularly within the distinctive landscape of environmentally sensitive firms in Bangladesh.

*H4:* The study reveals a nuanced and context-dependent relationship between gender diversity and CCD, challenging the consistency of past studies and theoretical expectations (Elmagrhi *et al.*, 2019; Al Kurdi *et al.*, 2023; Kanter, 2008). Contrary to the expectations outlined in *H4* and the theoretical premise of the neo-institutional perspective, which posits that diverse gender backgrounds on boards enhance managerial monitoring, stakeholder relationships, resource attraction and CG (Ntim *et al.*, 2013), our empirical results do not consistently support these expectations in the context of environmentally sensitive firms in Bangladesh. The mixed findings in contemporary literature regarding the impact of gender diversity on decision-making and CCD practices are reflected in our study (Liao *et al.*, 2015; Lu and Herremans, 2019; Al Kurdi *et al.*, 2023; Cucari *et al.*, 2018).

Notably, the absence of specific guidelines in CG regulations regarding the minimum required number of female directors might contribute to the lack of a significant relationship between gender diversity and CCD practices in our study. This indicates the importance of contextual factors and regulatory frameworks in shaping the influence of gender diversity on environmental disclosure within the studied firms in Bangladesh. The incorporation of female directors in firms may be driven by the desire to connect with various industry groups, attract resources and maintain corporate legitimacy rather than a regulatory mandate. Additionally, the power dynamics within boards, where the influence of female directors might be restricted compared to their male counterparts (Kanter, 2008), could explain the variation in results across different periods.

*H5:* The study reveals an insignificant negative relationship between the number of board meetings and CCD across all examined periods, contrary to the expectations outlined in *H5* (Wang *et al.*, 2022; Yusoff *et al.*, 2019; Hussain *et al.*, 2018). The lack of support for this hypothesis suggests that the frequency of board meetings does not necessarily result in increased CCD. The observed results may be influenced by regulatory pressures that mandate regular meetings, potentially diluting their impact on enhancing climate-change disclosures.

The findings consistently show no significant positive relationship between board meetings and CCD in Tables 5 and 7, consistent with previous studies by Wang *et al.* (2022), Yusoff *et al.* (2019) and Hussain *et al.* (2018). This finding indicates that the frequency of board meetings may not be a decisive factor in promoting CCD. Interestingly, Model 8 in Table 6 shows a significant negative relationship, similar to the findings of Frias-Aceituno *et al.* (2013), who suggested that more frequent board meetings imply an inactive and futile board. This contradictory result highlights the complexity of the relationship between board meetings and CCD, and the potential for varied outcomes depending on contextual factors and firm-specific characteristics.



*H6*: The study consistently demonstrates a negative and significant relationship between CEO duality and CCD across all periods, supporting *H6* (Hussain *et al.*, 2018). The findings suggest that having separate individuals in the roles of Chairman of the Board and CEO positively influences climate-friendly initiatives, in line with theoretical predictions and the existing literature that emphasizes the potential conflicts of interest associated with CEO duality.

CEO duality, where the same individual holds the positions of Chairman of the Board and CEO, is viewed as compromising governance, reducing board independence and promoting self-serving attitudes in decision-making (Dalton and Dalton, 2005; Greenwood *et al.*, 2013). The negative correlation observed in this study highlights the potential detrimental effects of concentrated power on a single individual, hindering a firm's ability to monitor and implement quality, accountability and sustainability practices, including CCDs. This finding is in line with regulatory recommendations that advocate for the separation of the Chairperson of the Board and the Managing Director/CEO roles (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018).

*H7*: A highly significant positive relationship between the audit committee and CCDs is consistently observed across all periods, supporting *H7* (Al-Shaer and Zaman, 2018). This aligns with regulatory recommendations and prior research that emphasizes the role of audit committees in enhancing transparency and disclosure practices. From a neo-institutional perspective, firms may accept coercive pressure from institutions to establish an audit committee. The audit committee, composed of executive and non-executive members with expertise in accounting and finance, plays a crucial role in protecting firms' financial integrity and encouraging CCD reporting (Greenwood *et al.*, 2013).

The significance of effective audit committees in overseeing the financial reporting process has been well established in prior studies (Alkayed and Omar, 2022; Al-Shaer and Zaman, 2018). While the primary role of an audit committee is associated with financial matters, its potential oversight of CCDs is increasingly recognized. The committee, composed of executive and non-executive members with expertise in accounting and finance, plays a crucial role in protecting against financial asymmetry and encouraging CCD reporting. This aligns with the mandatory inclusion of an audit committee in Bangladesh's CG guidelines (Securities and Exchange Commission, 2012; Bangladesh Securities and Exchange Commission, 2018).

Overall, the study findings highlight the significant influence of board characteristics on CCD, contributing valuable insights into the complex interplay between CG and environmental transparency. Specifically, larger boards, the presence of foreign directors and the existence of an audit committee were identified as positive and significant factors associated with increased CCD, consistent with previous research (Bui *et al.*, 2020). However, the study did not find strong connections between CCD and independent directors, despite their mandatory inclusion according to CGCs in Bangladesh. Additionally, the roles of female directors and board meetings appear to have a weaker association with CCD during both pre- and post-amendment periods. These findings suggest that regulatory bodies may need to scrutinize further to understand the reasons behind the limited implementation of climate laws and regulations, emphasizing the need for effective governance mechanisms in these areas (Alkayed and Omar, 2022). The identified factors can inform policymakers, corporate boards and investors by providing insights to promote sustainable governance practices and enhance environmental transparency in corporate reporting.

## 8. Conclusion

Over the past several decades, escalating concerns about climate change have prompted a surge in interest among academics, practitioners and policymakers regarding its

detrimental effects on the environment, socioeconomic systems and human lives (Orazalin *et al.*, 2023). In response to these challenges, regulatory bodies, including the BSEC, have implemented legislative initiatives to exert pressure on firms to adopt climate-friendly practices (Boiral *et al.*, 2019). Our research contributes to bridging the existing gap in understanding the roles of regulators and CG mechanisms in shaping CCD (Orazalin *et al.*, 2023). Focusing on 100 environmentally sensitive firms operating in Bangladesh between 2014 and 2021, we explore the intricate links between board processes and CCD by leveraging a dynamic multidimensional neo-institutional theoretical framework. We addressed Bangladesh, as it has recently achieved considerable economic growth via export-led industrialization (World Bank, 2012), and thus pays a heavy price in climate terms, as evident from its lower ranking in the 2020 Global Environmental Performance Index (Wendling *et al.*, 2020).

Our study delves into regulatory influences, specifically CGG, on CCD within highly environmentally sensitive firms responsible for significant climate damage (Elmagrhi *et al.*, 2019). The findings indicate significant positive associations between the level of climate disclosure and board size (BSIZE), foreign directors (FORDIR) and audit committees (ADCOM) both before and after the amendment. Additionally, independent directors show positive significance throughout the entire period, whereas female directors exhibit significance in the pre-amendment period. However, board meetings and duality demonstrated negative significance in the post-amendment period.

Unlike prior studies, our research examines a comprehensive spectrum of climate disclosures, encompassing air, water, renewable energy, climate activities, climate policies, direct and indirect climate initiatives and short- and long-term climate initiatives. The results reveal strong positive relationships between air- and water-related disclosures with foreign directors, while renewable energy disclosures correlate positively with board size, independence, foreign directors, board diversity and audit committees.

The practical and policy implications of our findings are multi-faceted. First, our research suggests that larger boards, foreign directors and audit committees tend to disclose more climate issues, thus emphasizing the importance of these governance structures. However, the roles of independent directors and female directors appear less significant, warranting regulatory scrutiny and potential enhancements to directors' abilities.

Second, regulatory authorities, such as the BSEC and policymakers, should formulate and enforce guidelines or policies on climate disclosure procedures, aligning them with binding carbon reduction targets. This becomes crucial, especially in the absence of mandatory carbon reporting, urging firms to obtain independent assurance to justify climate-change disclosures.

While our study makes significant contributions, it is not without its limitations. Future research in this area could explore the impact of CG on CCDs in SMEs and non-publicly traded firms, delve into the individual characteristics of board members, investigate ownership structures (family vs non-family), focus on specific carbon disclosures and scrutinize the regulatory impact on climate laws. These avenues aim to provide a more nuanced and comprehensive understanding of the relationship between CG and CCD.

## Notes

1. Regulations refer to the promulgation of an authoritative set of rules, accompanied by some mechanism for monitoring and promoting compliance with these rules (Baldwin *et al.*, 2011).
2. The Rana Plaza disaster, Savar, Bangladesh.
3. Available from [https://sec.gov.bd/slaws/Notification\\_on\\_CG-07.8.12-Amended.pdf](https://sec.gov.bd/slaws/Notification_on_CG-07.8.12-Amended.pdf).

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## Further reading

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## Appendix

**Table A1** Disclosure on Carbon in line with the GRI standards

<i>Disclosure items</i>	<i>GRI standards</i>
Disclosures related to the level of air pollution and control	11, 12, 13, 305
Disclosures related to the level of water pollution and control	3, 12, 13, 303
Disclosures related to the level of waste management and investment	11, 12, 306
Disclosures related to the level of energy savings and improvements	3, 302
Disclosures related to renewable energy and investment	3, 302
Disclosures related to the implementation of environmental, ecological and carbon management policies and strategies	2, 11
Disclosures related to gaining environmental certification, honour, award or appreciation for environmental initiatives and protections	11
Disclosures related to the environmental committee, separate department of environment and CSR	3
Disclosures related to important environmental initiatives and events, policy, strategy and implementation	2, 3
Disclosures related to community initiatives, including tree plantations and forestry	2, 11
Disclosures related to important environmental events, training and awareness program	3, 13, 401, 404
Disclosures related to climate change and global warming	3, 13

Source: Authors' own work

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