Do boards practice what they preach on nonfinancial disclosure? Evidence from China on corporate water information disclosures

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Abstract

Purpose – This study aims to examine whether and how gender diversity on corporate boards is associated with voluntary nonfinancial disclosures, particularly water disclosures.

Design/methodology/approach – This study uses corporate water information disclosure data from Chinese listed firms between 2010 and 2018 to conduct regression analyses to examine the association between female directors and water information disclosure.

Findings – Empirical results show that female directors have a significantly positive association with corporate water information disclosure. Additionally, internal industry water sensitivity of firms moderates this significant relationship.

Originality/value – This study determined that female directors can promote not only water disclosure but also positive corporate water performance, reflecting the consistency of words and deeds of female directors in voluntary nonfinancial disclosures.

Keywords Water information disclosure, Voluntary disclosure, Women on boards of directors, Corporate social responsibility, Nonfinancial disclosure, Critical mass

Paper type Research paper

1. Introduction

Environmental issues, especially water-related issues, have become key in restricting the change of social green and sustainable development. In the past ten years, water resources have received considerable attention, particularly owing to its importance during times wherein climate change and social change have become strategic issues particularly for larger companies. Therefore, more and more enterprises began disclosing water information in their annual reports or *standalone* environmental social and governance (ESG) reports. For example, while only nearly 600 publicly listed commercial companies disclosed water information in 2010 in our sample from China, that number increased to more than 900 by 2018. However, compared to the increase in water disclosure in practice, evidence of the initial

motivations for this behavior is scant, especially concerning board gender diversity. To the extent that board composition affects corporate governance outcomes and financial performance or influence investors' beliefs and judgments (Carter, D'Souza, Simkins, & Simpson, 2010; Dezsö & Ross, 2012; Vallelado & García-Olalla, 2022; Fondas, 2000), our results also provide insights into whether the number of women on boards provides investors with incrementally useful information.

We have noticed that there have been several studies about board gender diversity and CSR performance, but the conclusions are not the same (Al-Shaer & Zaman, 2016; Valls Martinez, Cruz Rambaud, & Parra Oller, 2019). Such gaps and differences not only affect the strategic choice of corporate CSR and nonfinancial related information disclosure but also seriously affect the identification of corporate information by investor-led stakeholders, thereby affecting their judgment on the company's prospects (Dhaliwal, Radhakrishnan, Tsang, & Yang, 2012). Thus, we extend these studies by specifically focusing on corporate water information disclosure, a branch of CSR and nonfinancial disclosure that has played an important role in social green transformation in recent years (Liu, Su, & Zhang, 2021; Zhou, Zhou, Zeng, & Chen, 2018a; Zhou, Liu, Zeng, & Chen, 2018b; Burritt, Christ, & Omori, 2016; Dobija, Arena, & Ma, 2020).

Although green transformation is a new dimension of the environment, water pollution, unlike other types of chemical pollution, can lead to global pollution with long-term and possibly irreversible harmful effects (CEO Water Mandate, 2021). Simultaneously, female directors pay less attention to economic affairs than their male counterparts. Moreover, their superior social and environmental orientation prompts them to pay more attention to corporate philanthropy, community participation (Dobija, Arena, Kozłowski, Krasodomska, & Godawska, 2022) and "care and responsibility". Furthermore, female directors have different perceptions, world views and values than men (Jia & Zhang, 2013), and they place a greater emphasis on disclosing nonfinancial information, such as donations, environmental protection and employee benefits, to improve corporate transparency and reduce information asymmetry (Al-Shaer & Zaman, 2016). Therefore, we believe that female directors are positively associated with water disclosure, and it helps to fill the research gap of female directors and water information disclosure and further explain the reasons for inconsistency of the relationship between female directors and nonfinancial disclosure.

Water is a vital part of natural capital (Hoekstra, Chapagain, Mekonnen, & Aldaya, 2011). The world's water resources are under increasing pressure through overuse, pollution, mismanagement and increasing water-related crisis for businesses facing climate change (CEO Water Mandate, 2021). This water crisis has become one of the top ten problems in the world (World Economic Forum, 2019) and, along with global population growth, rapid economic growth in developing countries, and climate change, lead to water supply challenges around the world. As available water resources diminish, companies face increased risks in materials, reputations and finances (Jones, Hillier, & Comfort, 2015). Therefore, global water scarcity remains an emerging risk for all companies to manage, and one about which investors and government need more information (Barton, 2010). Companies, especially in the manufacturing, agriculture, forestry, animal husbandry, fishing and mining, cover over 70% of the world's freshwater use and pollution and for a growing number of water scandals in recent years. However, one of the important reasons for this situation is that many companies have poor water performance and insufficient water information disclosure. Effective use and protection of natural resources is key to promoting green transformation of the entire human society. Therefore, we begin with gender diversity on corporate boards and then predict corporate reliability and contribution to social green transformation through impact on water disclosure.

Additionally, we explored the implications for Hypothesis 1 from the perspectives (i.e. risks from inside of the company) that are most directly related to water disclosure. We

hypothesize that the positive relationship between female directors and water information disclosure is moderated by the industry wherein the company's own attributes. After a series of robustness tests, our results are robust to potential endogeneity issues.

To expand on the setting for which female directors promote water information disclosure, we analyzed the above relationship considering the number and characteristics of female directors. To understand the impact of female directors on water disclosure, both presence and the number of female directors must be considered. Unlike the traditional three critical masses, Cook and Glass (2017) suggest that even a symbolic female director can promote positives of CSR. However, at the level of water information disclosure, whether it is a token or a critical mass is unclear. As top management is key in the development of CSR, the influence of female directors on water disclosure cannot be ignored.

Notably, our study examines whether female directors follow through when it comes to water disclosure in additional analyses. Irresponsible companies deliberately defrauding stakeholders of their environmental commitments to achieve a certain benefit is termed "greenwashing." Facing a deluge of nonfinancial disclosures, whether substantiated or not, creates difficulties for a variety of stakeholders attempting to differentiate between truly ethical companies and opportunistic companies that exploit sustainability trends (Parguel, Benoît-Moreau, & Larceneux, 2011). As CSR information disclosure has become the core content of corporate nonfinancial information disclosure in recent decades, under such circumstances, companies are increasingly being accused of "breaking their word." Essentially, CSR disclosures are not followed up or supported by actual corporate activities (Gatti, Pizzetti, & Seele, 2021). Therefore, to probe the positive role of female directors in corporate nonfinancial disclosure activities, we further tested the relationship between female directors and corporate water performance, as well as the relationship between water performance and water information disclosure. We find that female directors can not only promote the level of water information disclosure but also enhance the actual water performance of enterprises. The better the water performance of enterprises, the higher the level of water information disclosure.

Hence, our findings contribute to the literature in several ways.

(1) Our study extends the literature on corporate nonfinancial disclosures. Prior studies have been conducted on whether female directors can promote nonfinancial information disclosure (Husted & De Sousa-Filho, 2019; Ben-Amar, Chang & Mcllkenny, 2015; Liao, Luo, & Tang, 2014; Al-Qahtani & Elgharbawy, 2020); however, no unified conclusion has been reached. Owing to corporate nonfinancial information disclosure including many aspects, female directors affect different kinds of nonfinancial disclosures in various ways. As far as we know, the effect of female directors on water disclosure is still unclear. Water information disclosure is one of the key ways companies cope with global water shortages and promote green transformation (Liu *et al.*, 2021). Conversely, because of the nonmandatory and special nature of water information disclosure, it is different from CSR, carbon information and ESG disclosures in previous nonfinancial disclosures studies. Considering that China is one of the countries with the most serious water pollution in the world and the social status of women in China is different from that in western countries, we took Chinese companies as the research object and found that female directors can well promote corporate water information disclosure. This finding makes a significant contribution to the ongoing debate on the role of female directors in nonfinancial disclosure.

(2) We focused on the weight of female directors in developing countries' voice in corporate nonfinancial disclosure and CSR strategies. Previous studies in the

literature on the relationship between the number of female directors and nonfinancial disclosures are mixed. For example, Ben-Amar *et al.* (2015) provide evidence that female directors need to reach a critical mass of two before influencing disclosures on climate change strategies. However, in related research on CSR, Cook and Glass (2017) found that only the presence of a token female director can promote corporate CSR disclosure. Hence, in the process of corporate water information disclosure, is the role of female directors critical or token? In this study, we show that at least two female directors are required to positively influence water disclosure, which is consistent with the critical mass theory. Furthermore, our empirical results support the view of the "double critical mass" (Birindelli, Dell'Atti, Iannuzzi, & Savioli, 2018) of female directors and water disclosure, that is, a balanced number of men and women on the board is most beneficial to corporate nonfinancial disclosure. This finding enriches the existing literature on nonfinancial disclosures and female directors.

(3) We established that water performance has a mediating effect. Previous research has focused little on the relationship between board gender diversity and water performance. Thus, this study discusses the relationship between female directors, water performance and water information disclosure from the standpoint of whether nonfinancial information disclosure is motivated by "greenwashing". We find that female directors can promote positive water information disclosure by promoting enterprises' actual water performance. This is an important discovery that validates the specific transmission path of female directors to promote water information disclosure and demonstrates that female directors are more daring to "speak" because of their "actions". This result responds to the question of CSR "greenwashing", and it also compensates for a gap in the existing literature on whether female directors' words and actions are consistent in nonfinancial information disclosure. This provides a literature foundation for future research on board gender diversity and nonfinancial information disclosure.

Moreover, this study makes the following practical contributions to enterprises, stakeholders and regulators:

(1) Our findings help company stakeholders make better investment decisions. Previous research results on female directors and corporate nonfinancial information disclosure and corporate environmental performance are inconsistent (Husted & De Sousa-Filho, 2019; Ben-Amar *et al.*, 2015; García Martín & Herrero, 2020; Al-Qahtani & Elgharbawy, 2020), which make shareholders, creditors, consumers, government agencies and other stakeholders unable to make better decisions in practice. We found that female directors can promote water information disclosure, and this suggests that female directors can improve corporate transparency by facilitating disclosure of certain nonfinancial information (e.g. water information disclosure). Moreover, in additional analyses, empirical results show that female directors are positively correlated with enterprises' water performance. Combined with the above research, female directors can not only promote discussion but also promote execution of water issues. Furthermore, female directors are reliable in signaling and presenting authenticity in nonfinancial disclosure. Therefore, we clarify the debate surrounding the relationship between female directors and nonfinancial information disclosure. Simultaneously, because of the improvement of transparency and credibility, our findings can inform investors who select stocks according to board composition and CSR activity and can reduce the cost of

identifying information for stakeholders, analysts and government regulators, so they can make better decisions.

(2) Our research addresses the ongoing debate on the relationship between environmental disclosure and environmental performance (Clarkson, Li, Richardson, & Vasvari, 2007; Luo & Tang, 2014; Siddique, Akhtaruzzaman, Rashid, & Hammami, 2021), provides new empirical evidence that has not been recorded before (i.e. water information disclosure and performance) and positively responds to doubts about companies releasing environmental nonfinancial information to greenwashing. Moreover, we found that the actual water performance of companies is positively correlated with water disclosure, which means that if a company makes more efforts in water use, water discharge and so on, it will likely make more water disclosure. On the one hand, this finding is consistent with the voluntary disclosure theory, wherein firms tend to disclose "good" news and withhold "bad" news. Conversely, this result also follows the simplest economic rationale: more actors may pay more costs, so they should disclose more to obtain more benefits, while few actors will face greater risks if they arbitrarily disclose. These findings are critical for investors because many companies use nonfinancial disclosures as part of impression management to create a responsible and positive image to attract more investment.

(3) Our study provides important guidance for driving social change toward environmental sustainability. Although Chinese women's status in all walks of life has improved in recent years, they still play less key roles in society. This is because for women to hold important positions would be contrary to traditional Chinese culture, and this has aroused skepticism on women's ability and the positive role from all walks of life. We oppose traditional skepticism by focusing on female directors, water performance and water disclosure. Through empirical research, we found that participation of female directors enables companies to not only speak well but also act well in nonfinancial aspects (i.e. water). Owing to their consistency of words and deeds, they can not only improve the transparency of the company but can also encourage the whole society to move toward green. Therefore, enterprises should fully recognize the positive role of female directors in enhancing corporate transparency and environmental protection. For government management, this should begin from the aspect of policy formulation, provide strategies to support diversity of women at the top of the company and jointly promote green transformation of society with enterprises.

The remainder of this paper has been organized as follows. Section 2 presents related research on relationships between female directors and water information disclosure and develops the hypotheses. Section 3 explains our sample, variable definitions and methodology. Section 4 exhibits and discusses our multivariate results. Section 5 provides robustness checks. Section 6 introduces our additional analyses. Finally, we provide our conclusion and further research in Section 7.

2. Related research and hypothesis development
2.1 The role of board gender diversity
As representatives of the shareholders, the board of directors occupies a core position in the company's internal governance mechanism and shoulders the important mission of supervision, governance and decision-making (Srinidhi, Gul, & Tsui, 2011; Beasley, 1996). Therefore, the governance level and efficiency of the board of directors is key in the decision-

making of the company's environmental performance and the company's final nonfinancial information disclosure (Valls Martinez et al., 2019). Furthermore, independent directors, key personnel in the board of directors, are often willing to demonstrate their commitment to society to stakeholders by reporting nonfinancial information (e.g. CSR). This is because they prioritize their image, legitimacy and reputation (Pucheta-Martínez, Bel-Oms, and Olcina-Sempere, 2019; Harjoto & Jo, 2011). As independent directors are key in supervising and controlling the effectiveness of company managers and board of directors, independent directors in the board of directors can be considered as links between the company and its environment (Al-Shaer & Zaman, 2016), which can effectively promote the company's CSR performance and nonfinancial information disclosure. Hence, some characteristics of the board of directors and independent directors may have significant impact on decision-making related to the corporate environment and become an inherently powerful driving force for the green development of enterprises and social change. From the perspective of gender, inherent differences in physiological characteristics of men and women lead to natural differences in their thinking methods and perspectives, which may directly affect the final decision-making tendency of enterprises.

With continuous improvement of society's awareness of the importance of women's status and roles in enterprises, women's participation in the board of directors has become important in corporate decision-making. On female director traits, previous research has demonstrated that women are key in what remains to be a male-dominated business world (Kanter, 1977), relying on their knowledge and ability to participate in companies' decision-making processes. Female executives, assuming a greater role in management, are important for boards of directors (Chen, Torsin, & Tsang, 2021; Ben-Amar et al., 2015; Terjesen, Sealy, & Singh, 2009). Modern firms pay greater attention to diversity and its strategic implications, resulting in the increased interest in women's presence on boards of directors. Besides, women bring distinct characteristics to boards where they are considered to have a more participative, democratic and communal leadership style (Eagly & Carli, 2003; Eagly & Johnson, 1990; Rudman & Glick, 2001). Moreover, women have more sustainable conscience in their private sphere, which can be easily projected into their public activities (Fernandez-Feijoo, Romero and Ruiz-Blanco, 2014). Therefore, characteristics of female directors and their impact on corporate governance in all aspects of corporate governance have become important topics in corporate governance research.

Especially at the beginning of the 21st century, a series of financial scandals of superior companies, represented by Enron and WorldCom, and the financial crisis that swept the world caused by the sudden collapse of the Lehman Brothers in 2008, further triggered the international community's concerns about CSR and corporate governance, generating debate and reflection on the relationship between board composition and roles (Terjesen et al., 2009). Poor ethical culture has been cited as a reason for many corporate governance scandals (Di Miceli da Silveira, 2021), and several studies have confirmed the advantages of female directors in decision-making ethics compared with men. Briano-Turrent (2022) finds that female directors positively impact the ethical functioning of the board, development of a code of ethics and adoption of a stakeholder orientation. Similarly, Landry, Bernardi and Bosco (2016) surveyed 341 Fortune 500 companies from 2006 to 2012 and found that companies with a higher proportion of female directors were more respected and ethical and more likely to be included in the Fortune 500. Additionally, Di Miceli da Silveira (2021) reported that a higher proportion of women on independent directors and boards is associated with a better ethical culture in the business, including organizational trust, ethical leadership, a benevolent orientation, empathy and speaking out and efficacy. Isidro and Sobral (2015) suggested that participation of female directors can affect corporate value by their promotion of corporate ethics.

2.2 Board gender diversity and nonfinancial information disclosure

Previous studies (García Martín & Herrero, 2020; Kassinis, Panayiotou, Dimou, & Katsifaraki, 2016; Fernandez-Feijoo *et al.*, 2014; García-Sánchez, Martínez-Ferrero, & García-Meca, 2018) have demonstrated that female directors are more sensitive to environmental issues and have a positive role in the long-term sustainable development of enterprises (e.g. CSR and ESG related activities; and carbon disclosure). Specifically, a new global study shows that increase in proportion of female directors will help improve enterprises and make enterprises pay more attention to the protection of the environment (Galletta, Mazzù, Naciti, & Vermiglio, 2022). Owing to women's "greater inclination towards communal leadership, showing more affection, care, helpfulness, kindness, sympathy, interpersonal sensitivity, nurturing, concern for others, and proactive cooperation (Eagly and Carli, 2003; Dhaliwal *et al.*, 2012), they are more likely to prioritize maintaining relationships than men in terms of CSR and the environment, while responding to the needs of others, being more sensitive to certain stakeholders" demands, and consideration of multiple interests and perspectives. Hence, women's leadership styles are more social and ethical than men's (Jia & Zhang, 2013), and they are more likely to voluntary disclose more nonfinancial information and willing to work hard for the long-term development of the enterprise, improvement of the environment and CSR, and the overall interests of society.

Numerous studies have explored the relationship between female directors and CSR and nonfinancial disclosure (Ben-Amar *et al.*, 2015; Al-Shaer & Zaman, 2016; Valls Martinez *et al.*, 2019; Fernandez-Feijoo *et al.*, 2014), while the conclusions have been inconsistent. For instance, García Martín and Herrero (2020) find that, as women are more sensitive to environmental issues, board gender diversity is positively correlated with corporate environmental performance. Similarly, Cook and Glass (2017) also suggest that among Fortune 500 companies, the more female directors, the better the CSR performance. Besides, Fernandez-Feijoo *et al.* (2014) and Zhang, Zhu, and Ding (2013) find that the presence of female directors on board will positively impact the company's CSR and sustainability information disclosure.

However, some researchers highlighted that, in their latest study, previous studies on the relationship between female directors and CSR underestimated the multidimensionality of CSR. For example, through empirical research, Ardito, Dangelico and Messeni Petruzzelli (2021) confirmed that although female directors can promote overall CSR practice, for different dimensions of CSR, the role of female directors varies greatly. Husted and De Sousa-Filho (2019) further found that women on boards negatively impact ESG disclosure. Such gaps and differences not only affect the strategic choice of corporate CSR and nonfinancial related information disclosure but also seriously affect the identification of corporate information by investor-led stakeholders, thereby affecting their judgment on the company's prospects (Dhaliwal *et al.*, 2012). Hence, as an important branch of CSR in recent years, water information disclosure is one of the most important ways for companies to manage climate change (Liu *et al.*, 2021; Zhou *et al.*, 2018a). Simultaneously, as women can play a key active role in developing and strengthening climate change strategies (Loarne-Lemaire, Bertrand, Razgallah, Maalaoui, & Kallmuenzer, 2021), their relationship to water disclosure deserves further exploration and may contribute to the literature and provide important implications for capital markets.

2.3 Female directors and water information disclosure

Consistent with empirical evidence, many well-established theories also support a positive link between female directors and water information disclosure. For instance, the stakeholder theory shows that an interdependent relationship exists between enterprises and different stakeholders, and the managers of enterprises should consider stakeholders' interests

simultaneously. Not only should managers be responsible for the main provider of capital shareholders but other stakeholders such as factor providers and product consumers should be held accountable (Parmar, Freeman, Harrison, Wicks, Purnell, & de Colle, 2010). Stakeholder groups have a strong sense of demand for the level of corporate environmental information disclosure (Huang and Kung, 2010), and compared to male directors, female directors will consider the demands of shareholders, employees, consumers and other stakeholders more comprehensively and considerately when making decisions (Hussain, Rigoni, & Orij, 2018). Additionally, female directors also prioritize the impact of the company's daily activities on the environment more and are more concerned and responsible for CSR performance (Jizi, 2017).

Water information fulfillment and disclosure is not only a moral responsibility for an enterprise, but it is also an inherent need to attract and retain strategic resources. Water disclosure is a driving factor in cost reduction and operational efficiency. Only capital input from shareholders, without elemental input and strong support from other primary stakeholders (e.g. consumers, employees, suppliers, etc.) and secondary stakeholders (e.g. media, government, special interest groups, etc.), the business ultimately, it is impossible to continue to create value for shareholders in a going concern manner. From this perspective, owing to the influence of their own characteristics, female directors are more likely to actively perform water information disclosure for the company's long-term development, and they are also more likely to meet stakeholders information needs to evaluate whether the company is effectively implementing CSR and then promote, compile and disclose reports related to CSR and environmental protection. Extending these views to independent directors, independent female directors have positive impact on CSR issues as women prioritize stakeholder demands and are more likely to prompt companies to disclose CSR information (Al-Shaer & Zaman, 2016). To summarize, according to stakeholder theory, the presence of women on boards and independent female directors can strengthen relationships with stakeholders, which enhances interest in environmental information (e.g. water information) disclosure (García Martín & Herrero, 2020; Hussain et al., 2018).

Overall, the upper echelons theory can also confirm the role of female directors in promoting corporate water information disclosure from another perspective. The upper echelons theory demonstrates the psychological structure of the top management team's cognitive ability and perception ability, and values determines the strategic decision-making process and corresponding performance results of the enterprise (Hambrick & Mason, 1984). Conversely, gender, occupation, education and other factors are closely related to the cognitive and perception abilities of the management team. From the perspective of gender characteristics, women have different ethical and moral judgment criteria than men. Women are also more concerned about the performance of enterprises in the environment and the image of enterprises in society (Park, Choi, & Kim, 2012), and they are more inclined to improve their connection with the community (Hillman, Cannella, & Harris, 2002). Specifically, women's compassion, more emotional and maternal care make them more inclined to focus on the impact of employees, investor protection and environmental issues on society, which generate the underlying message that companies are important participants in social welfare.

Regarding these characteristics, Boulouta (2013) found that female directors are more risk averse, cautious and attentive to the company's nonfinancial performance such as environmental protection and disclosure of related information. To summarize, the upper echelons theory elicits the role of the presence of women in the boardroom in promoting water-related decision-making from the perspective of the relationship between managerial heterogeneity and corporate governance. Because women are especially sensitive to environmental politics (Nielsen & Huse, 2010), gender differences promote their performance of water-related activities. Moreover, owing to their willingness to disclose this information to

the outside world to establish a positive image of the company and promote information transparency, the presence of female directors ultimately leads to changes in corporate strategy. Additionally, evidence for the contribution of female directors to environmental behavior and disclosure performance can be found in many other theories (e.g. feminist caring, legitimacy, agency, socialization and resource dependence theories) (Gilligan, 1993; Adams & Ferreira, 2009; García Martín & Herrero, 2020; Pan & Sparks, 2012; Hillman, Cannella, & Paetzold, 2000).

Overall, both empirical evidence and theoretical, support a significant association between female and nonfinancial disclosures (e.g. information about CSR activities). Therefore, we present H1 as follows:

H1. *Ceteris paribus*, female directors and female independent directors are significant and positively associated with corporate water information disclosure.

If we find evidence consistent with our hypothesis that female directors and female independent directors contribute to corporate water disclosure, the next question involves the specific circumstances wherein this relationship has the strongest effect. The effect of female directors can be contextual as the company's own internal characteristics can affect stakeholders' needs for water information and female directors' water-related decisions. To provide some insight into this issue, we explored the impact of this factor on the female director–water disclosure relationship: the water sensitivity of the company's industry.

2.4 Water-sensitive industry and the relationship between female directors and water disclosure
Previous research has shown that a company's industry is a key factor in determining its voluntary disclosure strategy (Meek, Roberts, & Gray, 1995; Stanny & Ely, 2008; Ben-Amar *et al.*, 2015). Yu (2021) analyzed a small group of companies in China's manufacturing industry and discovered that water-sensitive companies have positive water disclosures. High water-sensitive industries (e.g. mining, manufacturing, animal husbandry, power, heat, etc.) are more likely to attract the attention of stakeholders (Kuo, Yeh, & Yu, 2012), and their operations are closely watched and scrutinized by the government, investors and the public. Because high water-sensitive industries have serious wastewater discharge and pollution problems, they always faced more external pressures and internal risks compared to low water-sensitive industries. For instance, environmental problems caused by water pollution likely directly affect the stability and harmony of the community. Hence, regulators typically give these companies extra attention (Gamerschlag, Möller, & Verbeeten, 2011; Burritt *et al.*, 2016); as for enterprises, if the pollution problem is not handled properly, the positive image of the enterprise will be damaged and the cost of capital will be increased (Liu *et al.*, 2021). At worst, it may trigger a stock price crash and seriously affect the normal order of the market. Therefore, regardless of the type of the stakeholder, they will put more pressure on companies in high water-sensitive industries to disclose water-related information compared to companies operating in low water-sensitive industries (Burritt *et al.*, 2016).

Regarding the internal risks and external pressures faced by enterprises, female directors have higher risk aversion tendencies and may prioritize "soft" issues such as social responsibility (Boulouta, 2013). Hence, they are more sensitive to CSR performance and cautious in dealing with issues related to environmental risks (e.g. water risk). Higher water-sensitive industries face greater pressure from government regulators on water issues; because of the requirements of corporate legality, female directors influence the internal coordination mechanism and decision-making process of the board of directors with different characteristics compared to men. Their prudent and rule-abiding personalities can strengthen enterprises' compliance with the legal system related to the environment,

strengthen enterprises' awareness of the importance of environmental protection, change the moral atmosphere of management, and, through information disclosure, help the enterprise to obtain a legal status. Stakeholders expect environmentally sensitive industries to meet higher environmental and water disclosure requirements compared to nonenvironmentally sensitive industries (Yu *et al.*, 2020; Gamerschlag *et al.*, 2011). Female directors are more socially oriented compared to men and emphasize care and responsibility; these directors are more able to benefit stakeholders and prioritize and address issues related to the environment from stakeholders' perspectives (Mendonça & Reis, 2020; Bernardi, Bosco, & Vassill, 2006; Dobija *et al.*, 2022). Therefore, when the high water-sensitive industries are more concerned, participation of female directors is more likely to make enterprises respond to the demands of stakeholders by disclosing more information about water.

In summary, female directors are likely to urge enterprises to deal with various water-related problems by disclosing more water information. Moreover, the higher the water sensitivity of the industry to which enterprises belongs to, the greater the external pressure they face, and the more significant this effect may be. Therefore, our second hypothesis is formally stated as follows:

H2. Ceteris paribus, the positive relationship between female directors and water information disclosure is stronger among enterprises belonging to the high water-sensitive industry.

3. Sample, variable definitions and methodology
3.1 Sample selection and data collection
To cover more industries, we select all 2010–2018 A-share listed companies in China as our original sample. Because Chinese companies have been required to disclose CSR, corporate sustainability and other environmental-related reports since 2010, 2010 was chosen as the starting year (Zhou *et al.*, 2018a). We then screened the samples through the following steps: (1) exclude observations without water information disclosure, (2) exclude observations belonging to the financial industry and (3) exclude observations without complete financial data. Ultimately, Table 1 shows the 7,099 observations.

Table 2 presents industry distribution of the final sample for 17 categories, demonstrating that the level of water information disclosure varies greatly among different industries. In the sample, the manufacturing industry accounted for more than half of the disclosure – nearly 60% – and other industries disclosed less than 10%.

The data sources are as follows:

(1) Female director data and other financial data are gathered from the China Stock Market and Accounting Research Database (http://www.gtarsc.com);

Sample selection process	Dropped	Sample
All available observation in the CSMAR database with firm-identifying information from 2010 to 2018		24,932
Drop observations without water information disclosure	16,902	8,030
Drop observations in the financial industry	430	7,600
Drop observations without dependent variables or controls in the main regression model	501	7,099
Final sample		7,099
Note(s): CSMAR database: China Stock Market and Accounting Research Database		

Industry name	Industry code	Sample size	Proportion (%)
Agriculture, forestry, livestock farming and fishery	A	94	1.32%
Mining	B	311	4.38%
Manufacturing	C	4,157	58.56%
Electricity, heat, gas and water production and the supply industry	D	349	4.92%
Construction	E	232	3.27%
Wholesale and retails, and transportation	F	380	5.35%
Transportation, warehousing and postal service	G	371	5.23%
Accommodation and catering	H	18	0.25%
Information transmission, software and information technology services	I	345	4.86%
Real estate	K	446	6.28%
Leasing and business services	L	59	0.83%
Scientific research and technical services	M	37	0.52%
Water conservancy, environment and public facilities management	N	61	0.86%
Resident, repair and other services	O	7	0.10%
Education	P	0	0.00%
Sanitation and social work	Q	24	0.34%
Culture, sports and entertainment	R	113	1.59%
Comprehensive	S	95	1.34%

Note(s): The 17 water-specific industries in CEO Water Mandate (2014) correspond to five industries in the *Guidelines for Industry Classification of Listed Companies in China (2012)*; their industry codes are A01–A04, B07, C13–C41, D44–D46 and N76–N78

(2) Water information disclosure data are collected and organized manually, and the original data come from *Financial Reports*, *CSR Reports*, *Corporate Sustainability Reports*, *Corporate Environmental Impact Annual Reports* and other environmental-related reports;

3.2 Variable description
Our main variables are female directors, water information disclosure and water sensitivity. We describe how each of these variables is measured, and Appendix 1 provides a summary of the variables employed and definitions.

3.2.1 Female directors. For the independent variable, we use three proxies of female representation on the board of directors: (i) the number of women (denoted by *Gender_num*), which is the number of female directors on the board; (ii) proportion of women (denoted by *Gender_ratio*), which is the number of women on the board divided by the total number of board members; and (iii) the number of independent female directors (denoted by *Gender_ind*), which is the number of female independent directors on the board. These approaches are consistent with those of Al-Shaer and Zaman (2016). Valls Martinez *et al.* (2019) argue that the board decision is the result of comprehensive discussion among all directors (both men and women). Hence, if the characteristics of women will have an impact on water disclosure, it will be revealed through the above three measures of gender diversity on the board.

3.2.2 Water information disclosure. Water information disclosure is the dependent variable. To obtain more real, objective and comprehensive water information, we use the water information disclosure scale proposed by Liu *et al.* (2021). This scale includes 37 indicators for eight items of water information disclosure, covering almost all aspects of the water information disclosure field and supported by previous research (Cantele *et al.*, 2018;

CDP, 2020; Global Reporting Initiative, 2013; Zhou *et al.*, 2018a). For instance, the water footprint of the supply chain proposed by Hoekstra *et al.* (2011) has been added to reflect the indirect water consumption of the upstream and downstream supply chains and make the calculation results more accurate. Therefore, this scale is more comprehensive and practical. We then scored each item in the scale in two ways: 1 if the company disclosed the corresponding water information and 0 if otherwise. The sum of these scores +1 takes the natural logarithm to obtain the final value of the dependent variable water information disclosure (denoted by *Water_disclosure*).

We manually score water information to obtain more objective data. Owing to the particularity of Chinese characters, filtering out interfering information using only computer software is impossible. Although the workload of manual methods is huge, we improve data reliability by reading the context, thereby ensuring the objectivity of the conclusions. Moreover, to ensure the reliability and validity of the water information disclosure data, we conducted three tests on the data and water information disclosure scale according to Liu *et al.* (2021). The results show that our water information disclosure data are reliable. To better support H1, we also use the dummy variable of whether companies disclose water information as a substitute measure of the dependent variable to demonstrate the promotion effect of female directors on corporate water information disclosure (*Water_dummy*). It is denoted by 1 if the company disclosed water information and 0 otherwise.

3.2.3 Water sensitive. Water sensitive (denoted by *Water_sensitive*) is a moderating variable, which is equal to 0 if the enterprise belongs to the 17 water-specific industries listed in CEO Water Mandate (2014), and 1 if otherwise corresponding to the five highly water-sensitive industries in *the Guidelines for Industry Classification of Listed Companies in China (2012),* namely, agriculture, forestry, livestock farming and fishery (A01–A04); mining (B07); manufacturing (C13–C41); electricity, heat, gas and water production, and the supply industry (D44–D46); and water conservancy, environment and public facilities management (N76–N78), shown in Table 2. Previous studies have found that a significant positive correlation exists between industry environmental sensitivity and CSR performance (Valls Martinez *et al.*, 2019). Therefore, we speculate that higher water sensitivities may lead companies to prioritize water information issues, which will potentially help female directors influence water information disclosure.

3.2.4 Control variables. We also consider several control variables, such as four financial variables and four corporate governance determinants variables. We refer to previous studies on CSR, female directors, water information disclosure and environmental information disclosure (Zhou *et al.*, 2018b; Valls Martinez *et al.*, 2019; Burritt *et al.*, 2016; Boulouta, 2013; Brammer & Pavelin, 2006; Wang, Luo, Wang, & Hu, 2021) and use the following variables as our control variables.

Financial variables are as follows: (1) Firm size (*Size*) is measured by the natural logarithm of total assets. Large companies tend to receive greater social attention, and they will undergo more scrutiny from all walks of life; hence, they will prioritize their own image on the environment (Boulouta, 2013). Additionally, larger companies often have more resources and capabilities to devote to environment-related activities (Valls Martinez *et al.*, 2019); (2) Financial leverage (*Lev*), is measured by total liabilities divided by total assets. Higher leverage may reduce the financial resources of managers to provide environmental disclosures (Brammer & Pavelin, 2006), which may directly affect water disclosures; (3) Return on assets (*ROA*), is ratio of earnings before interests and income taxes to total assets. Previous studies have highlighted that the higher the ROA, the more transparent, ethical and CSR activities the company can have (Barrientos Báez, Báez-García, Flores-Mun~oz, & Gutiérrez-Barroso, 2018; Wang *et al.*, 2021). Therefore, ROA is likely to have impact on water disclosure; and (4) Tobin's Q (*Tobin's Q*), is an objective measure of market performance, which reflects external perceptions and expectations about a company's future or long-term

value (Post & Byron, 2015). Previous studies have found a positive correlation between Tobin's Q and corporate environmental information disclosure (Ben-Amar *et al.*, 2015; Valls Martinez *et al.*, 2019).

We further control for four corporate governance determinants variables that might be associated with water disclosure: (1) CEO–chairperson duality (*Dual*) is a dummy variable equal to 1 if the CEO also serves as a chairman and 0 if otherwise. Previous studies have shown a contradicting result on the relationship between dual roles and corporate voluntary disclosures. Some empirical results suggest that level of voluntary disclosure is suppressed when duality exists as duality reduces the board's objectivity as a supervisory body (Lim, Talha, Mohamed, & Sallehhuddin, 2008; Chau & Gray, 2010). Conversely, CEO duality helps with CSR disclosures to relieve strong stakeholder pressure or to increase tenure and compensation (Jizi, 2017); (2) Board size (*Board*) is measured by the natural log of the total number of board members. While boards with large numbers of directors may have more agency problems and are less interested in disclosures (Prado-Lorenzo, Gallego-Alvarez, & Garcia-Sanchez, 2009), more board members may also lead to more communication on environmental issues and may include more environmental experts, leading to water information disclosure; (3) Corporate ownership type (*SOE*), in China, enterprises can be roughly divided into two categories, state-owned enterprises (SOEs), and non-state-owned enterprises (non-SOEs), according to their ownership types. In keeping with the previous literature (Liu *et al.*, 2021), we have defined *SOEs* as a dichotomous variable, which is equal to 1 if the enterprise belongs to SOEs and 0 if otherwise. Different ownership types have different effects on CSR (See, 2009); hence, different ownership types will have some impact on the relationship between female directors and water disclosure; (4) Firm age (*Age*) is measured by the natural logarithm of the sum of the listed age of the firm plus 1. Siddique *et al.* (2021) and de Villiers, Naiker, and van Staden (2011) suggested that older companies are more willing to engage in environmental activities as they have the resources to do so at relatively low cost. Hence, we use firm listed age as a control variable.

Moreover, we control year and industry dummy variables in our regressions. Appendix 1 summarizes the definitions and measurement methods of all variables.

3.3 Empirical models
To analyze the relationship between female directors and water information disclosure, we followed Zhou *et al.* (2018) and Fernandez-Feijoo *et al.* (2014) and estimate the following model to test H1:

$$Water\_dummy_{i,t} = \alpha_0 + \alpha_1 \cdot Gender\_num_{i,t} + \alpha_2 \cdot Gender\_ratio_{i,t} + \alpha_3 \cdot Gender\_ind_{i,t}$$
$$+ \alpha_4 \cdot Control_{i,t} + \varepsilon_{i,t} \tag{1}$$

$$Water\_disclosure_{i,t} = \alpha_0 + \alpha_1 \cdot Gender\_num_{i,t} + \alpha_2 \cdot Gender\_ratio_{i,t} + \alpha_3 \cdot Gender\_ind_{i,t}$$
$$+ \alpha_4 \cdot Control_{i,t} + \varepsilon_{i,t} \tag{2}$$

To further test the influence of the moderating effects of the water-sensitive industry on the relationship between female directors and water information disclosure (i.e. H2), we introduce one group of interaction terms based on Model 2, and the test models are as follows:

$$Water\_disclosure_{i,t} = \alpha_0 + \alpha_1 \cdot Gender\_all_{i,t} + \alpha_2 \cdot Water\_sensitive_{i,t}$$
$$+ \alpha_3 \cdot Gender_{i,t} \cdot Water\_sensitive_{i,t} + \alpha_4 \cdot Control_{i,t} + \varepsilon_{i,t} \tag{3}$$

In the above models, $Control_{i,t}$ denotes all control variables (shown in Appendix 1). The number of female directors ($Gender\_num_{i,t}$), the proportion of female directors (*the number of*

female directors on the board divided by the total number of directors on the board) and the number of female independent directors (*Gende_ind$_{i,t}$*) is represented by *Gender_all$_{i,t}$*, and i denotes the individual corporation, t denotes the period and the error term is $\varepsilon_{i,t}$.

4. Results
4.1 Descriptive statistics and correlations
Tables 3 and 4 present the descriptive and correlation statistics (Pearson and Spearman), respectively, of the dependent, independent and control variables. In the descriptive statistical analysis results of each variable in Table 3, the average value of the water information disclosure score of enterprises is 1.385, minimum value is 0 and maximum value is only 2.639. This indicates that overall water information disclosure of Chinese enterprises is at a low level. Moreover, even among the few companies that have disclosed water information, the degree of disclosure is not high. Combined with the industry distribution in Table 2, the only companies that disclose water information are mostly concentrated in the manufacturing industry. This shows that, at present, companies in most industries in China are probably unaware of the water crisis and its impact on the future development of companies or underestimating the positive impact of water disclosure. The average number of female directors is 1,091, and the maximum value is 4, which indicates that there is an average of one and a maximum of four female directors in the sample companies. The average ratio of female directors is 0.122, which indicates that female directors account for 12.2% of the seats on the board of directors, with only one female director for every ten on the board of directors. The maximum value is only 0.444, indicating that the proportion of women on the board of directors of companies with the highest proportion of female directors in the sample is less than 50%. The average number of female independent directors is 0.528, and the maximum value is 2, indicating that the average number of female independent directors less than 1 and the maximum number is not more than 2 on the board of directors, which further suggests that board gender diversity is low. Additionally, the mean value of water-sensitive industries is 0.341, indicating that less than half of the sample companies belong to highly water-sensitive industries. The average value of corporate ownership type is 0.580, which indicates that about 60% of the enterprises in the sample belong to SOEs. Compared with non-SOEs, SOEs tend to disclose more water information.

Variable	Obs.	Mean	Media	Std. Dev.	Min.	Max.
Water_disclosure	7,099	1.385	1.386	0.695	0.000	2.639
Water_dummy	24,001	0.278	1.000	0.448	0.000	1.000
Gender_num	7,099	1.091	1.000	1.055	0.000	6.000
Gender_ratio	7,099	0.122	0.111	0.119	0.000	0.444
Gender_ind	7,099	0.528	0.000	0.663	0.000	3.000
Water_sensitive	7,099	0.341	0.000	0.474	0.000	1.000
Size	7,099	22.900	22.760	1.390	20.180	25.990
Lev	7,099	0.488	0.497	0.205	0.060	0.920
Roa	7,099	0.042	0.036	0.054	−0.166	0.197
SOE	7,099	0.580	1.000	0.494	0.000	1.000
Dual	7,099	0.184	0.000	0.387	0.000	1.000
Board	7,099	0.375	0.364	0.055	0.333	0.571
Tobin's Q	7,099	1.924	1.495	1.254	0.903	8.144
Age	7,099	2.395	2.565	0.640	0.693	3.219

Table 3.
Descriptive statistics

Note(s): This table presents the summary statistics for the main variables used in regression analyses. All variables are defined in Appendix 1

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)Water_disclosure		0.505***	0.025**	0.050***	0.028**	−0.018	0.336***	0.126***	−0.091***	0.202***	−0.114***	−0.007	−0.271***	0.137***
(2)Water_dummy	0.643***		0.081***	0.086***	0.024***	0.012	0.150***	0.058***	−0.040***	0.085***	−0.062***	−0.027**	−0.109***	0.051***
(3)Gender_num	0.015**	0.006		0.967***	0.699***	−0.054***	−0.090***	−0.083***	0.042***	−0.156***	0.081***	−0.078***	0.048***	0.042***
(4)Gender_ratio	0.040***	0.006	0.960***		0.675***	−0.055***	−0.136***	−0.106***	0.043***	−0.202***	0.111***	−0.008	0.081***	0.041***
(5)Gender_ind	0.030**	0.016	0.698***	0.673***		−0.078***	−0.051***	−0.051***	−0.002	−0.049***	0.023*	−0.002	0.028**	0.075***
(6)Water_sensitive	−0.013	−0.062***	−0.053***	−0.047***	−0.079***		0.201***	0.160***	−0.017	−0.105***	−0.061***	0.086***	−0.156***	0.070***
(7)Size	0.338***	0.433***	−0.098***	−0.139***	−0.058***	0.196***		0.515***	−0.105***	0.299***	−0.121***	0.064***	−0.605***	0.281***
(8)Lev	0.127***	0.170***	−0.081***	−0.098***	−0.047***	0.155***	0.508***		−0.462***	0.224***	−0.097***	0.015	−0.459***	0.233***
(9)Roa	−0.069***	−0.035***	0.032***	0.031***	0.008	−0.029**	−0.059***	−0.427***		−0.152***	0.068***	−0.018	0.345***	−0.176***
(10)SOE	0.204***	0.273***	−0.153***	−0.172***	−0.028***	−0.127***	0.354***	0.308***	−0.097***		−0.280***	−0.023*	−0.237***	0.325***
(11)Dual	−0.113***	−0.125***	0.079***	0.109***	0.023*	−0.061***	−0.116***	−0.100***	0.055***	−0.299***		0.081***	0.112***	−0.151***
(12)Board	−0.004	0.003	−0.093***	−0.016	−0.009	0.079***	0.084***	0.033***	−0.016	−0.060***	0.078***		0.007	0.021*
(13)Tobin's Q	−0.214***	−0.103***	0.015	0.044***	0.01	−0.074***	−0.471***	−0.371***	0.267***	−0.125***	0.087***	0.044***		−0.161***
(14)Age	0.154***	0.226***	0.011	0.016	0.062***	0.055***	0.268***	0.273***	−0.163***	0.428***	−0.166***	0.011	−0.073***	

Note(s): Lower-triangular cells report Pearson's correlation coefficients, upper-triangular cells are Spearman's rank correlation. All variables are defined in Appendix 1. ***p < 0.01, **p < 0.05, *p < 0.1

Table 4.
Correlation matrix

Table 4 reports the correlations (Pearson and Spearman) among main variables. Consistent with H1, female directors from three proxies (*Gender_num*, *Gender_ratio* and *Gender_ind*) are significantly positively correlated with *Water_disclosure*. Correlation coefficients between surrogate variables measuring the number of female directors are all above 0.5 and significant at the 0.01 level, which indicates that surrogate variables measuring the independent variables have high correlation. Correlation coefficients between the independent and control variables and the control variables are very weak. Only two coefficient values exceed 0.5; the correlation coefficients of company size (*Size*) and financial leverage (*Lev*) are 0.515 and 0.508, and the correlation coefficients between company size (*Size*) and Tobin's *Q* (*Tobin'Q*) is −0.605, and the correlation coefficients between other variables are all below 0.5; hence, the collinearity between the variables is not serious. Additionally, we tested the multicollinearity of the regression model and found that the variance inflation factors (VIFs) is much smaller than the cutoff value of 10 (the maximum VIF value is 1.51, and the mean VIF value is 1.13), and tolerance is between 0 and 1. Thus, multicollinearity is not an important issue in our study.

4.2 Regression results
Table 5 presents the empirical results of the test of H1. Based on Model (1) and Model (2), we found a positive correlation between female directors and water information disclosure. Specifically, the estimated coefficient of *Gender_num* (coef. 0.005, $P < 0.01$; coef. 0.016, $P < 0.05$), *Gender_ratio* (coef. 0.017, $P < 0.05$; coef. 0.104, $P < 0.1$) and *Gender_ind* (coef. 0.006, $P < 0.1$; coef. 0.037, $P < 0.01$) were significant impact on water information disclosure indicating that the number and proportion of female directors' participation in board governance has a significant role in promoting corporate water information disclosure. This supports previous research on the promotion of CSR information disclosure by female directors (García Martín & Herrero, 2020; Cook & Glass, 2017; Jia & Zhang, 2013), and gender diversity on the board can still play a positive role in promoting information disclosure even at the level of water information disclosure. Therefore, H1 was supported.

Table 6 presents regression results for testing H2; we group the overall sample according to the company's water sensitivity and explore the impact of female directors on water information disclosure when the company's own industry risks are different (i.e. internal risk of water information). Empirical results in Table 6 show that when the multiplication of female directors and industry sensitivity is added, the direct influence coefficients of the three proxies of female directors on water information disclosure are all positive and significant (coef. 0.020, $P < 0.01$, coef. 0.159, $P < 0.05$, coef. 0.048, $P < 0.01$). Three groups of interaction terms are all negative and significant (coef. −0.023, $P < 0.1$, coef. −0.246, $P < 0.05$, coef. −0.045, $P < 0.05$). As 0 represents industries with high water sensitivity and 1 represents industries with low water sensitivity, the above results indicate that corporate water industry sensitivity positively affects promotion relationship of female directors to water information disclosure. Consistent with our prediction, compared with companies belonging to the low water sensitivity industry, the promotion effect of female directors on water information disclosure is more evident for companies in high water-sensitive industries, supporting H2.

Above all, we found evidence consistent with H1 and H2: female directors can facilitate water disclosure, and this relationship is more pronounced in highly water-sensitive industries. Next, we conduct some robustness tests to provide more conclusive evidence to support our findings.

5. Robustness tests
Our results show that a significant positive relationship between female directors and water disclosure exists, and water sensitivity positively moderates this relationship. However, the

Variable	Water_dummy			Water_disclosure		
	(1)	(2)	(3)	(4)	(5)	(6)
Gender_num	0.005*** (3.007)			0.016** (2.532)		
Gender_ratio		0.017** (1.995)			0.104* (1.788)	
Gender_ind			0.006* (1.936)			0.037*** (3.751)
Size	0.220*** (19.099)	0.220*** (19.877)	0.220*** (19.049)	0.140*** (19.878)	0.140*** (19.868)	0.140*** (19.955)
Lev	−0.184*** (−14.083)	−0.183*** (−14.031)	−0.184*** (−14.062)	−0.078* (−1.672)	−0.080* (−1.703)	−0.080* (−1.720)
Roa	−0.078* (−1.911)	−0.079* (−1.944)	−0.079* (−1.939)	−0.597*** (−4.177)	−0.597*** (−4.178)	−0.605*** (−4.238)
SOE	0.150*** (28.048)	0.150*** (27.920)	0.149*** (27.906)	0.099*** (6.161)	0.099*** (6.136)	0.097*** (6.070)
Dual	−0.005 (−1.006)	−0.005 (−0.956)	−0.004 (−0.901)	−0.088*** (−4.863)	−0.088*** (−4.857)	−0.087*** (−4.784)
Board	−0.124*** (−3.033)	−0.112*** (−2.755)	−0.112*** (−2.748)	−0.277*** (−2.211)	−0.302*** (−2.424)	−0.307*** (−2.461)
Tobin'Q	−0.055*** (−29.228)	−0.054*** (−29.197)	−0.055*** (−29.219)	−0.021*** (−3.182)	−0.021*** (−3.238)	−0.021*** (−3.134)
Age	0.004 (1.282)	0.005* (1.791)	0.005* (1.694)	0.059*** (5.248)	0.057*** (5.072)	0.057*** (5.069)
Constant	−4.790*** (−7.068)	−4.776*** (−6.940)	−4.777*** (−7.277)	−1.320*** (−5.199)	−1.307*** (−5.141)	−1.322*** (−5.222)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Obs	24,001	24,001	24,001	7,099	7,099	7,099
Adj-R^2	0.472	0.472	0.472	0.331	0.331	0.332
F	483.4	482.9	483.1	93.03	92.9	93.35

Note(s): This table presents the regression results for the effect of female directors on water information disclosure. Columns (1), (2) and (3) depict the relationship between the three proxies of female directors and the dummy variable of water disclosure. Meanwhile, Columns (4), (5) and (6) show the relationship between the three proxies of female directors and the water disclosure index. The t-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 5.
Test of Hypothesis 1

Variable	(1)	Water_disclosure (2)	(3)
Gender_num	0.020*** (2.681)		
Gender_ratio		0.159** (2.240)	
Gender_ind			0.048*** (4.009)
Water_sensitive	0.122 (1.229)	0.120 (1.209)	0.133 (1.341)
Gender_num* Water_sensitive	−0.023* (−1.742)		
Gender_ratio* Water_sensitive		−0.246** (−1.991)	
Gender_ind* Water_sensitive			−0.045** (−2.065)
Size	0.138*** (19.364)	0.139*** (19.326)	0.139*** (19.471)
Lev	−0.084* (−1.760)	−0.084* (−1.768)	−0.088* (−1.853)
Roa	−0.619*** (−4.247)	−0.619*** (−4.247)	−0.629*** (−4.317)
SOE	0.099*** (6.045)	0.099*** (6.000)	0.096*** (5.877)
Dual	−0.089*** (−4.837)	−0.089*** (−4.811)	−0.088*** (−4.803)
Board	−0.292** (−2.291)	−0.313** (−2.463)	−0.312** (−2.458)
Tobin's Q	−0.019*** (−2.781)	−0.019*** (−2.840)	−0.018*** (−2.748)
Age	0.055*** (4.798)	0.053*** (4.691)	0.053*** (4.669)
Constant	−1.803*** (−8.646)	−1.791*** (−8.590)	−1.815*** (−8.731)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Obs	7,099	7,099	7,099
Adj-R^2	0.315	0.314	0.315
F	82.87	82.82	83.21

Note(s): The regression results for water sensitive as a moderator variable on the relationship between female directors and water disclosure are presented in this table. Columns (1), (2) and (3), respectively show how water sensitivity moderates the relationship between female directors and water information disclosure under the three proxies of female directors. The *t*-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 6.
Test of Hypothesis 2

results may be affected by endogeneity issues like omitted variable bias, measurement error, sample selection bias and self-selection problems. To allay this concern and confirm our previous evidence, we conducted a number of robustness checks: alternative proxies for independent variables, additional control variables, Heckman's two-stage regression and propensity score matching (PSM) analyses.

5.1 Alternative proxies for independent variable
To confirm previous evidence, first, we use the Blau (1977) Index of heterogeneity as a proxy of female directors, which is measured as $Blau = 1 - \sum_{i=1}^{2} P_i^2$, where $i = (1, 2)$ for the number of gender categories (i.e. male and female) and P is the proportion for each category (male or female) on the board. For board gender diversity, the Blau Index ranges from 0, where only one gender is represented on the board, to 0.5, where the number of female and male directors on the board is equal. Therefore, values vary between 0 and 0.5, where 0 represents perfect homogeneity, and 0.5 indicates perfect heterogeneity. As the Blau Index is an ideal measurement of gender diversity (Miller & Triana, 2009) and combines both "balance" (proportion of women) and "variety" (presence of at least one woman), many previous studies have used this to test the impact of board gender diversity on CSR reporting (Ben-Amar *et al.*, 2015; Gulzar, Cherian, Hwang, Jiang, & Sial, 2019). Table 7 presents the results of Blau Index as independent variables on Models 2 and 3 to test H1 and H2. Regression results are similar to those in Section 4.

Variable	Water_disclosure	
	(1)	(2)
Gender_blau	0.089** (2.066)	0.136*** (2.643)
Water_sensitive		0.118 (1.229)
Gender_blau*Water_sensitive		−0.154* (−1.707)
Size	0.140*** (20.229)	0.140*** (20.209)
Lev	−0.080* (−1.738)	−0.080* (−1.733)
Roa	−0.540*** (−3.842)	−0.545*** (−3.877)
SOE	0.095*** (6.027)	0.095*** (5.997)
Dual	−0.101*** (−5.694)	−0.102*** (−5.739)
Board	−0.247** (−2.017)	−0.250** (−2.039)
Tobin's Q	−0.024*** (−3.659)	−0.024*** (−3.652)
Age	0.057*** (5.214)	0.057*** (5.195)
Constant	−1.787*** (−6.956)	−1.889*** (−9.324)
Year	Yes	Yes
Industry	Yes	Yes
Obs	7,099	7,099
Adj-R^2	0.345	0.345
F	97.49	92.53

Note(s): This table presents the regression results of robustness tests examining the effect of female directors on water information disclosure using other alternative measures of the independent variable. Column (1) shows the impact of female directors on water disclosure; Column (2) presents the results for water sensitivity as a moderator. The *t*-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 7.
Robustness tests:
independent variable
substitution tests

5.2 Additional control variables

We control some other variables to test the robustness of our results to avoid the influence of unknown factors inside and outside the enterprise on water information disclosure. First, Zhou, Zhang, Chen, Zeng and Chen (2020) showed that the intensity of industry competition influences water information disclosure. Thus, we include the Herfindahl–Hirschman Index (*HHI*) to measure the intensity of competition in the industry. Second, we consider *OwnershipConcentration* (Burritt *et al.*, 2016), which is the percentage of total shares owned by the top five shareholders. Third, we include internal control (*Inter_control*) because it has the potential to influence CSR behavior (Dhar, Harymawan, & Sarkar, 2022). Fourth, following Burritt *et al.* (2016), we include media exposure (*Media*) as a control variable. Finally, we follow Boesso and Kumar (2007), who argue that market instability and volatility will affect enterprises' voluntary information disclosure behavior. As a result, we use the beta coefficient (*Beta*) to measure company volatility. We verified Hypotheses 1–2 by substituting the above control variables into Models (2) and (3), respectively. Table 8 displays the results. Nonetheless, our findings are consistent with Tables 5 and 7

5.3 Two-stage regression

Evidence discussed earlier shows that female directors can promote corporate water information disclosure, and internal risk (i.e. the water-sensitive industry) positively moderates this relationship. Although we control for many factors related to water disclosure and use a number of proxies to measure female directors, controls may remain insufficient. This may be because larger and better-run companies may have more women on the board of directors. Simultaneously, such companies may also have better performance in environmental and social responsibility or women are more inclined to prioritize the environmentally and socially responsible companies (e.g. disclosure of more water information). As a result, these companies may then increase the number of female

Table 8.
Robustness tests:
additional control
variables

Variable	Water_disclosure					
	(1)	(2)	(3)	(4)	(5)	(6)
Gender_num	0.017*** (2.619)			0.023*** (2.901)		
Gender_ratio		0.102* (1.706)			0.156** (2.135)	
Gender_ind			0.041*** (3.998)			0.055*** (4.402)
Water_sensitive				0.164 (1.620)	0.166 (1.643)	0.178* (1.770)
Gender_num*Water_sensitive				−0.028* (−1.930)		
Gender_ratio*Water_sensitive					−0.233* (−1.839)	
Gender_ind*Water_sensitive						−0.051** (−2.248)
Size	0.149*** (16.218)	0.149*** (16.184)	0.150*** (16.308)	0.146*** (15.575)	0.145*** (15.530)	0.146*** (15.613)
Lev	−0.128*** (−2.595)	−0.129*** (−2.621)	−0.130*** (−2.636)	−0.136*** (−2.706)	−0.136*** (−2.718)	−0.140*** (−2.797)
Roa	−0.626*** (−4.263)	−0.625*** (−4.257)	−0.636*** (−4.331)	−0.641*** (−4.280)	−0.640*** (−4.268)	−0.654*** (−4.368)
SOE	0.091*** (5.392)	0.091*** (5.329)	0.089*** (5.315)	0.089*** (5.174)	0.089*** (5.108)	0.086*** (5.006)
Dual	−0.082*** (−4.317)	−0.082*** (−4.313)	−0.081*** (−4.250)	−0.083*** (−4.286)	−0.082*** (−4.261)	−0.082*** (−4.261)
Board	−0.282*** (−2.205)	−0.309** (−2.418)	−0.315** (−2.467)	−0.315** (−2.418)	−0.337*** (−2.588)	−0.338*** (−2.603)
Tobin Q	−0.022*** (−3.162)	−0.022*** (−3.217)	−0.021*** (−3.096)	−0.020*** (−2.934)	−0.021*** (−2.993)	−0.020*** (−2.903)
Age	0.035** (2.385)	0.036** (2.403)	0.033** (2.221)	0.030** (1.972)	0.031** (2.030)	0.028* (1.865)
Growth	0.007 (0.590)	0.019 (0.587)	0.001 (0.621)	0.153 (0.560)	0.179 (0.579)	0.163 (0.568)
HHI	−0.239* (−1.818)	−0.242* (−1.841)	−0.247* (−1.879)	−0.235* (−1.746)	−0.238* (−1.769)	−0.235* (−1.751)
OwnershipConcentration	0.270** (2.522)	0.269** (2.514)	0.271** (2.534)	0.280** (2.551)	0.280** (2.547)	0.281** (2.560)
Inter_control	−0.006 (−1.116)	−0.006 (−1.107)	−0.006 (−1.112)	−0.008 (−1.308)	−0.007 (−1.281)	−0.007 (−1.271)
Media	−0.01 (−1.547)	−0.01 (−1.489)	−0.01 (−1.501)	−0.006 (−0.961)	−0.006 (−0.908)	−0.006 (−0.870)
Beta	0.227* (1.931)	0.228* (1.936)	0.228* (1.941)	0.219* (1.833)	0.219* (1.837)	0.222* (1.863)
Constant	−2.385*** (−10.119)	−2.365*** (−10.031)	−2.384*** (−10.153)	−2.275*** (−9.576)	−2.264*** (−9.527)	−2.276*** (−9.599)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Obs	7,099	7,099	7,099	7,099	7,099	7,099
Adj-R²	0.319	0.318	0.32	0.302	0.302	0.304
F	70.82	70.69	71.15	63.59	63.48	63.95

Note(s): This table displays the regression results of robustness tests that used more control variables to investigate the effect of female directors on water information disclosure. Columns (1) and (4) detail how Gender_num, as an independent variable, influences water information disclosure. Meanwhile, Columns (2) and (5) detail how Gender_ratio, as an independent variable, influences water information disclosure. Lastly, Columns (3) and (6) describe how Gender_ind, as an independent variable, influences water information disclosure. The t-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***p < 0.01, **p < 0.05, *p < 0.1

directors on their boards, and these issues likely created endogeneity problems. Therefore, we perform Heckman's two-stage analysis (Heckman, 1976) to mitigate the endogeneity concern and improve the robustness of our results.

For the first-stage estimation, we added two exogenous instrumental variables (Gulzar *et al.*, 2019) known to affect the number of female directors on the board but not directly related to the dependent variable (i.e. water disclosure), namely, the number of female directors in one lag period (*L_Gender*) and the average number of female directors in the same industry in the same period (*Aver_Gender*). Take the presence of female directors (*Gender*) as the explained variable, and equal to 1 when there are female directors in the company and 0 if otherwise. Additionally, we also included all control variables included in Model 1. Appendix 3 shows the results of the first-stage regression using the probit model, and, consistent with our expected results, both *L_Gender* and *Aver_Gender* are significantly associated with *Gender*. We then added the inverse Mills ration (*IMR*) obtained in the first stage into the full regression model as a control variable to control possible sample selection bias. The number of female directors (*Gender_num*), proportion of female directors (*Gender_ratio*) and number of independent female directors (*Gender_ind*) are also used as explanatory variables. Table 9 shows that most of the *IMR* are significant at the 0.01 level, except for Columns (2) and (5) in Panel A, which are significant at the 0.05 level. This indicates that a selection bias in the sample in this study exists, and estimation by two-stage regression is reasonable. After controlling for the self-selection effect of the sample, the regression results are basically consistent with Section 4, which indicates that our study results are robust.

5.4 Propensity score matching
Although the Heckman two-stage model showed that our results are robust, we also found that our data contain sample selection bias. Therefore, further using PSM to further verify the consistency of the conclusions to overcome the potential threat posed by the natural differences of samples to the model results is necessary.

First, we regressed each covariate using the presence of female directors (*Gender*) as the dependent variable to estimate the propensity score for each variable. Next, each treatment group (discloses water information) was matched to a control group (does not discloses water information) using nearest-neighbor matching without replacement. The matching process produced 4,551 pairs of samples from the treatment and control groups. Some natural differences in basic characteristics between companies that disclose water information and companies that do not disclose water information may be found, reducing effectiveness of model estimation. Finally, we reestimate the previous regression model using matched samples (Table 10), and we find that the results obtained by using the PSM method are similar to those reported in Tables 5 and 9, which supports the robustness of that our results.

6. Additional analyses
In this section, we conducted three further analyses on the relationship between female directors and water disclosure to complement the literature and theoretical gaps on this topic. First, we tested the quantitative effect of female directors on water disclosure. This test provides additional evidence for our main findings in Section 4. We then investigate whether presence of female directors contributes to a firm's actual water performance, which answers the debate on whether board gender diversity is "greenwashing" in CSR behavior. Finally, we use corporate water performance as a mediating variable to further explore the internal mechanism of female directors in promoting water information disclosure. These tests provide additional evidence for promoting green transformation in businesses.

Panel A: IV: the number of female directors on the board with a lag of one period

			Water_disclosure			
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Gender_num	0.041*** (4.299)			0.050*** (4.677)		
Gender_ratio		0.277*** (3.052)			0.359*** (3.555)	
Gender_ind			0.058*** (−4.825)			0.075*** (5.378)
Water_sensitive				0.126 (1.266)	0.126 (1.266)	0.143 (1.438)
Gender_num* Water_sensitive				−0.031** (−2.260)		
Gender_ratio* Water_sensitive					−0.256** (−2.060)	
Gender_ind* Water_sensitive						−0.052** (−2.326)
IMR	0.136*** (3.293)	0.106** (2.449)	0.092*** (2.766)	0.148*** (3.525)	0.121*** (2.763)	0.109*** (3.228)
Size	0.141*** (19.845)	0.142*** (19.935)	0.141*** (19.930)	0.139*** (19.285)	0.140*** (19.368)	0.140*** (19.413)
Lev	−0.099** (−2.103)	−0.102** (−2.150)	−0.105** (−2.220)	−0.105** (−2.180)	−0.107** (−2.208)	−0.114** (−2.367)
Roa	−0.609*** (−4.243)	−0.612*** (−4.263)	−0.625*** (−4.356)	−0.632*** (−4.319)	−0.633*** (−4.322)	−0.649*** (−4.431)
SOE	0.098*** (5.999)	0.099*** (6.053)	0.092*** (5.690)	0.098*** (5.889)	0.099*** (5.945)	0.091*** (5.472)
Dual	−0.082*** (−4.473)	−0.083*** (−4.520)	−0.080*** (−4.357)	−0.081*** (−4.369)	−0.082*** (−4.401)	−0.080*** (−4.286)
Board	−0.364*** (−2.825)	−0.400*** (−3.038)	−0.396*** (−3.059)	−0.391*** (−2.979)	−0.426*** (−3.181)	−0.419*** (−3.180)
Tobin's Q	−0.022*** (−3.360)	−0.023*** (−3.422)	−0.022*** (−3.322)	−0.020*** (−2.982)	−0.020*** (−3.058)	−0.020*** (−2.974)
Age	0.050*** (4.028)	0.049*** (3.930)	0.048*** (3.878)	0.046*** (3.646)	0.045*** (3.589)	0.044*** (3.522)
Constant	−2.537*** (−7.274)	−2.526*** (−7.232)	−2.523*** (−7.241)	−1.789*** (−8.512)	−1.789*** (−8.511)	−1.795*** (−8.563)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Obs	7,099	7,099	7,099	7,099	7,099	7,099
Adj-R²	0.326	0.325	0.327	0.31	0.309	0.311
F	86.72	86.35	86.91	77.52	77.19	77.78

Panel B: IV: the average number of female directors on board in the same year and industry

			Water_disclosure			
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Gender_num	0.021*** (3.309)			0.025*** (3.290)		
Gender_ratio		0.151*** (2.589)			0.210*** (2.947)	
Gender_ind			0.041*** (4.191)			0.052*** (4.362)
Water_sensitive				0.158 (1.590)	0.154 (1.552)	0.169* (1.708)
Gender_num* Water_sensitive				−0.023* (−1.702)		
Gender_ratio* Water_sensitive					−0.258*** (−2.102)	
Gender_ind* Water_sensitive						−0.044** (−2.047)

(*continued*)

Table 9.
Robustness tests: the second stage regression results of Heckman's two-stage model

Panel B: IV: the average number of female directors on board in the same year and industry

Variable			Water_disclosure			
	(1)	(2)	(3)	(4)	(5)	(6)
IMR	0.827*** (7.639)	0.820*** (7.571)	0.816*** (7.570)	0.830*** (7.529)	0.827*** (7.504)	0.823*** (7.498)
Size	0.120*** (16.181)	0.121*** (16.257)	0.121*** (16.277)	0.119*** (15.782)	0.120*** (15.805)	0.120*** (15.894)
Lev	−0.056 (−1.195)	−0.058 (−1.233)	−0.059 (−1.267)	−0.061 (−1.291)	−0.062 (−1.301)	−0.067 (−1.405)
Roa	−0.483*** (−3.380)	−0.485*** (−3.390)	−0.494*** (−3.454)	−0.506*** (−3.464)	−0.507*** (−3.474)	−0.517*** (−3.543)
SOE	0.058*** (3.419)	0.059*** (3.471)	0.055*** (3.289)	0.058*** (3.350)	0.058*** (3.367)	0.054*** (3.139)
Dual	−0.067*** (−3.672)	−0.067*** (−3.688)	−0.065*** (−3.578)	−0.068*** (−3.662)	−0.068*** (−3.654)	−0.067*** (−3.610)
Board	−0.894*** (−6.018)	−0.922*** (−6.198)	−0.924*** (−6.223)	−0.908*** (−6.015)	−0.935*** (−6.185)	−0.932*** (−6.173)
Tobin's Q	−0.024*** (−3.703)	−0.025*** (−3.762)	−0.024*** (−3.664)	−0.022*** (−3.321)	−0.023*** (−3.388)	−0.022*** (−3.300)
Age	−0.001 (−0.105)	−0.004 (−0.260)	−0.003 (−0.224)	−0.006 (−0.426)	−0.008 (−0.550)	−0.007 (−0.528)
Constant	−0.621** (−2.310)	−0.617** (−2.293)	−0.621** (−2.312)	−1.100*** (−4.830)	−1.087*** (−4.773)	−1.112*** (−4.892)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Obs	7,099	7,099	7,099	7,099	7,099	7,099
Adj-R^2	0.337	0.337	0.338	0.32	0.32	0.321
F	92.88	92.7	93.15	82.87	82.8	83.18

Note(s): This table presents the regression results of robustness tests examining the effect of female directors on water information disclosure by using Heckman's two-stage model. In Panel A, L_Gender is an exogenous instrumental variable; in Panel B, $Aver\_Gender$ is an exogenous instrumental variable. Columns (1) and (4) detail how $Gender\_num$, as an independent variable, influences water information disclosure. Meanwhile, Columns (2) and (5) detail how $Gender\_ratio$, as an independent variable, influences water information disclosure. Lastly, Columns (3) and (6) describe how $Gender\_ind$, as an independent variable, influences water information disclosure. The t-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1.***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 9.

Variable	(1)	(2)	(3)	Water_disclosure (4)	(5)	(6)
Gender_num	0.010* (1.665)			0.035*** (3.255)		
Gender_ratio		0.105** (1.973)			0.282*** (2.853)	
Gender_ind			0.029*** (2.910)			0.062*** (3.414)
Water_sensitive				−0.091*** (−5.619)	−0.091*** (−5.649)	−0.088*** (−5.400)
Gender_num* Water_sensitive				−0.054*** (−2.759)		
Gender_ratio* Water_sensitive					−0.484*** (−2.707)	
Gender_ind* Water_sensitive						−0.027*** (−2.793)
Size	0.149*** (22.892)	0.163*** (25.989)	0.149*** (22.957)	0.194*** (25.110)	0.194*** (25.116)	0.194*** (25.127)
Lev	−0.259*** (−6.091)	−0.366*** (−8.755)	−0.262*** (−6.142)	−0.589*** (−11.997)	−0.587*** (−11.963)	−0.595*** (−12.126)
Roa	−0.941*** (−7.004)	−1.075*** (−8.171)	−0.946*** (−7.046)	−1.517*** (−9.256)	−1.517*** (−9.254)	−1.512*** (−9.223)
SOE	0.045** (2.424)	0.046** (2.496)	0.045** (2.388)	0.104*** (5.546)	0.105*** (5.593)	0.102*** (5.421)
Dual	−0.030* (−1.870)	−0.022 (−1.354)	−0.029* (−1.813)	0.03 (−1.479)	0.03 (−1.476)	0.031 (−1.538)
Board	−0.221* (−1.871)	−0.211* (−1.772)	−0.238** (−2.023)	−0.211 (−1.449)	−0.218 (−1.491)	−0.221 (−1.513)
Tobin's Q	−0.035*** (−5.467)	−0.049*** (−8.008)	−0.035*** (−5.438)	−0.038*** (−4.815)	−0.038*** (−4.818)	−0.038*** (−4.816)
Age	0.084*** (7.353)	0.120*** (10.885)	0.083*** (7.291)	0.103*** (7.516)	0.102*** (7.494)	0.103*** (7.559)
Constant	−3.150*** (−7.515)	−3.436*** (−8.152)	−3.158*** (−7.537)	−2.651*** (−15.281)	−2.652*** (−15.281)	−2.651*** (−15.281)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Obs	9,102	9,102	9,102	9,102	9,102	9,102
Adj-R²	0.302	0.285	0.302	0.229	0.228	0.229
F	106.2	125.9	106.5	90.33	90.2	90.4

Note(s): This table presents the regression results of robustness tests examining the effect of female directors on water information disclosure by using PSM. Columns (1) and (4) detail how Gender_num, as an independent variable, influences water information disclosure. Meanwhile, Columns (2) and (5) detail how Gender_ratio, as an independent variable, influences water information disclosure. Lastly, Columns (3) and (6) describe how Gender_ind, as an independent variable, influences water information disclosure. The t-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***p < 0.01, **p < 0.05, *p < 0.1

Table 10.
Robustness tests: PSM
(sample = 9102)

6.1 Token or critical mass

Although our main results show that female directors can significantly facilitate corporate water disclosure, exactly how many female directors in numbers would have this effect is unknown. The relevance of female directors to CSR has been the subject of debate in recent decades and remains relevant to specific numbers (Amorelli & García-Sánchez, 2021). For instance, scholars who support the token theory of female directors believe that even being one female director can make a huge contribution to CSR (Wang *et al.*, 2021; Cook & Glass, 2017). This is because, according to the token theory (Kanter, 1977), a female director can provide enough symbolic status to remove barriers contributing to CSR. However, the critical mass theory (Granovetter, 1978) suggests that the influence of a subgroup depends on its size; when a minority reaches critical mass, the nature of group interactions changes, and a subgroup's degree of influence increases (Amorelli & García-Sánchez, 2021).

Recent studies show that CSR or carbon disclosure can only be affected if the number of female directors reaches a certain number, such as two or three, which is also sound (Jia & Zhang, 2013; Ben-Amar *et al.*, 2015; Cabeza-García, Fernández-Gago, & Nieto, 2018). The merely "token" female directors is easily overlooked (Atif, Alam, & Hossain, 2020), and they have little real impact on environmental issues (McGuinness, Vieito, & Wang, 2017). Additionally, female directors exceeding a certain threshold may lead to a decrease in CSR-related reports, and no linear relationship exists between female directors and CSR reports (Pucheta-Martínez *et al.*, 2019). According to the social identity theory, an increase in the number of female directors on a board can lead to uncooperative behavior of male directors, which manifests in more disagreement and lack of communication (Kravitz, 2003). When this number exceeds a certain threshold, it will lead to a reduction in CSR disclosures (Pucheta-Martínez *et al.*, 2019). To summarize, several conflicting views on the impact of the number of female directors on CSR disclosure and that on water information disclosure is unknown so far. To solve this black box problem, we group the women by the number from low to high according to Cook and Glass (2017) and Ben-Amar *et al.* (2015). We then also estimate Model (2) within each of the total six groups.

Table 11 presents the results. We can see results from Column (1) wherein while the coefficient is negative when there is only one female director in the firm, it is not statistically significant (coef. -0.008, $P > 0.1$). This result suggests that if a male-dominated board has only one female director, their presence is likely as "token" and not useful for water disclosure. The results in Columns (2) to (5) are positive and significant and are particularly significant in Columns (3) and (4) (coef. 0.066, $P < 0.01$, coef. 0.118, $P < 0.01$). These results show that the presence of more than or equal to two women on the board of directors can influence the decision-making of the board of directors and improve the level of water information disclosure. This is more evident when the number of female directors is more than two and less than five (i.e. 3–4 female directors). This supports the previous prediction of the critical mass theory that, when more than two female directors are present, water disclosure will be very limited. This finding is consistent with previous findings on carbon disclosure (Ben-Amar *et al.*, 2015). As shown in Column (6), Table 11, when the female director is the maximum value of 6, the result is positive but not as significant as before (coef. 0.038, $P < 0.1$). Significance level tends to decrease as the number of people increases. Hence, based on the above results, we tested whether a U-shaped relationship between the number of female directors and voluntary water disclosure exists. However, the results show nonlinear relationship between the number of female directors and voluntary water disclosure. Results are not shown for brevity.

6.2 Environmental friendly or greenwashing

Disclosure of nonfinancial information related to the environment by companies does not solve the problem of information asymmetry by itself as managers may be "greenwashing"

Table 11.
Additional Test 1

Variable	(1)	(2)	(3)	(4)	(5)	(6)
			Water_disclosure			
Fdum1	−0.008 (−0.570)					
Fdum2		0.021* (1.410)				
Fdum3			0.066*** (3.068)			
Fdum4				0.118*** (3.283)		
Fdum5					0.131* (1.794)	
Fdum6						0.038 (1.323)
Size	0.145*** (20.826)	0.146*** (20.916)	0.146*** (21.000)	0.145*** (20.910)	0.145*** (20.902)	0.145*** (20.873)
Lev	−0.081* (−1.735)	−0.079* (−1.676)	−0.078* (−1.667)	−0.080* (−1.706)	−0.082* (−1.756)	−0.081* (−1.729)
Roa	−0.654*** (−4.575)	−0.656*** (−4.587)	−0.659*** (−4.611)	−0.657*** (−4.603)	−0.660*** (−4.619)	−0.657*** (−4.592)
SOE	0.095*** (5.918)	0.097*** (6.071)	0.099*** (6.162)	0.097*** (6.076)	0.096*** (5.999)	0.095*** (5.944)
Dual	−0.107*** (−6.012)	−0.109*** (−6.118)	−0.109*** (−6.141)	−0.108*** (−6.095)	−0.108*** (−6.047)	−0.108*** (−6.050)
Board	−0.315** (−2.516)	−0.300** (−2.391)	−0.285** (−2.274)	−0.293** (−2.339)	−0.302** (−2.416)	−0.310** (−2.478)
Tobin's Q	−0.022*** (−3.338)	−0.022*** (−3.267)	−0.021*** (−3.220)	−0.021*** (−3.244)	−0.022*** (−3.293)	−0.022*** (−3.315)
Age	0.077*** (7.190)	0.078*** (7.243)	0.078*** (7.317)	0.081*** (7.488)	0.079*** (7.313)	0.077*** (7.182)
Constant	−2.166*** (−12.768)	−2.202*** (−13.000)	−2.227*** (−13.165)	−2.208*** (−13.097)	−2.201*** (−13.027)	−2.181*** (−12.901)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Obs	7,099	7,099	7,099	7,099	7,099	7,099
Adj-R^2	0.327	0.327	0.328	0.328	0.328	0.327
F	93.93	94.01	94.32	94.38	94.06	93.93

Note(s): $Fdum1 = 1$ if firms with more than zero female on the board, otherwise 0; $Fdum2 = 1$ if firms with more than one female on the board, otherwise 0; $Fdum3 = 1$ if firms with more than two female on the board, otherwise 0; $Fdum4 = 1$ if firms with more than three female on the board, otherwise 0; $Fdum5 = 1$ if firms with more than four female on the board, otherwise 0; $Fdum6 = 1$ if firms with more than five female on the board, otherwise 0. The t-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

by deliberately exaggerating or even fabricating content in their favor to support their claims of being environmentally friendly (Parguel *et al.*, 2011; Seele & Gatti, 2017). The tenth edition of the Concise Oxford English Dictionary defines greenwashing as follows:

"Greenwashing is disinformation disseminated by an organization so as to present an environmentally responsible public image".

In academia, the view that CSR greenwashing is rampant in the past decade has attracted a lot of attention (Pope & Wæraas, 2016; Qian & Schaltegger, 2017). Alves (2009) even asserts that false CSR claims are "everywhere." The surge in greenwashing could have a profound negative impact on consumer and investor confidence in corporate green claims (Gosselt, van Rompay, & Haske, 2019). This is because, on the one hand, greenwashing behavior will lead to negative reactions of investors to CSR activities (Krüger, 2015), further aggravating information asymmetry and increasing the cost of capital for enterprises. Conversely, external stakeholders usually want to know when the published environmental policy commitments will translate into actual policy implementation. When companies fail to deliver on their promises (i.e. greenwashing), CSR disclosures can be misleading (Nyilasy, Gangadharbatla, & Paladino, 2014), outsiders have doubts about the authenticity of CSR activities and the purpose of managers – thereby damaging the company's reputation – and ultimately negatively affecting consumer attitudes and behaviors (Pope & Wæraas, 2016). However, because money drives out good money, companies that are truly active in implementing CSR may be misunderstood, and it may reduce the effectiveness of their CSR initiatives. Therefore, the motivation for the water information disclosure and its authenticity are issues that we focus on to remove possible doubts about its greenwashing.

Our results in Section 4 show that female directors promote corporate water disclosure. However, whether this improvement in CSR-related nonfinancial information disclosure is mere "greenwashing" or true green transformation is unknown. To overcome this key doubt, we tested two sets of relationships, namely, relationship between female directors and water performance, and the relationship between water performance and water information disclosure. Because current research on water information disclosure remains in its infancy, and there is less relevant reference to measure water performance, we refer to the method of measuring carbon performance by Luo and Tang (2021) to design a set of indicators for measuring water performance (denoted by *Water_perfor*) with score of 0–5, including qualitative and quantitative performance (show in Appendix 2).

Particularly, considering that differences in external water risks faced by companies likely have a significant impact on water performance, the same decisions made by companies facing different risks are not comparable. Therefore, we multiply the water performance score by the inverse of the company's external water risk to ensure data comparability. Besides, to ensure data reliability, we also use manual methods to extract key data. Specifically, quantitative data are collected from *China Industrial Statistical Yearbook*, *China Environmental Statistical Yearbook*, *China Stock Market and Accounting Research Database* (http://www.gtarsc.com), corporate CSR reports, ESG reports, financial reports and the company's website. Qualitative data are gathered from the website of the China Securities Regulatory Commission (http://www. csrc.gov.cn) and *China National Knowledge Infrastructure full-text database of important Chinese newspapers* (http://kns.cnki.net). We use the China Water Risk Assessment Report 2013 (Wang, Su, & Gan, 2013) jointly developed by World Wide Fund for Nature (WWF) and Chinese researchers based on *WWF water risk assessment tool* (WWF, 2012) as a method to measure enterprise water risk, and the range of each firm's annual score is 0–5.

We perform the regression using only data of high water-sensitive firms, because the water performance data of high water-sensitive industries is more comprehensive. We select high water-sensitive industries in the initial total sample here, remove companies with no information or invalid information, and obtain 4,901 observations. Columns (2), (5) and (8) in Table 12 present the empirical results, and the coefficient of three proxies of female directors

Variable	Water_disclosure (1)	Water_perfor (2)	Water_disclosure (3)	Water_disclosure (4)	Water_perfor (5)	Water_disclosure (6)	Water_disclosure (7)	Water_perfor (8)	Water_disclosure (9)
Gender_num	0.021*** (2.637)	0.071*** (4.765)	0.019*** (2.449)						
Gender_ratio				0.167** (2.260)	0.499*** (3.634)	0.157** (2.222)			
Gender_ind							0.050*** (4.131)	0.054** (2.347)	0.047*** (4.001)
Water_perfor			0.234*** (21.635)			0.234*** (21.655)			0.233*** (21.633)
Size	0.111*** (12.197)	0.144*** (7.814)	0.082*** (9.397)	0.111*** (12.252)	0.149*** (8.083)	0.083*** (9.457)	0.112*** (12.342)	0.149*** (7.969)	0.084*** (9.542)
Lev	−0.03 (−0.507)	0.121 (1.047)	−0.017 (−0.296)	−0.03 (−0.508)	0.105 (0.907)	−0.017 (−0.294)	−0.036 (−0.607)	0.1 (0.847)	−0.022 (−0.392)
Roa	−0.526*** (−2.979)	0.074 (0.240)	−0.475*** (−2.812)	−0.525*** (−2.971)	0.068 (0.218)	−0.474*** (−2.806)	−0.547*** (−3.097)	0.012 (0.038)	−0.494*** (−2.928)
Dual	0.070*** (3.400)	−0.034 (−0.837)	0.054*** (2.727)	0.072*** (3.448)	−0.03 (−0.729)	0.056*** (2.791)	0.066*** (3.193)	−0.056 (−1.351)	0.050** (2.534)
SOE	−0.102*** (−4.526)	−0.127*** (−3.309)	−0.084*** (−3.917)	−0.102*** (−4.530)	−0.126*** (−3.284)	−0.084*** (−3.924)	−0.100*** (−4.466)	−0.124*** (−3.199)	−0.083*** (−3.861)
Board	−0.523*** (−3.176)	−0.517* (−1.706)	−0.406*** (−2.582)	−0.558*** (−3.397)	−0.663** (−2.196)	−0.437*** (−2.784)	−0.558*** (−3.403)	−0.653** (−2.131)	−0.437** (−2.791)
Tobin's Q	−0.038*** (−4.595)	−0.012 (−0.831)	−0.034*** (−4.296)	−0.038*** (−4.645)	−0.014 (−0.979)	−0.034*** (−4.340)	−0.037*** (−4.538)	−0.011 (−0.738)	−0.033*** (−4.238)
Age	0.101*** (6.873)	−0.019 (−0.637)	0.098*** (7.015)	0.098*** (6.666)	−0.028 (−0.930)	0.096*** (6.813)	0.098*** (6.714)	−0.023 (−0.746)	0.096*** (6.863)
Constant	−1.521*** (−7.320)	−2.984*** (−7.640)	−0.969*** (−4.841)	−1.511*** (−7.273)	−2.967*** (−7.577)	−0.962*** (−4.810)	−1.533*** (−7.406)	−3.015*** (−7.517)	−0.983*** (−4.930)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	5,031	5,031	5,031	5,031	5,031	5,031	5,031	5,031	5,031
Adj-R²	0.238	0.094	0.305	0.238	0.09	0.304	0.239	0.0877	0.306
F	45.99	7.788	62.34	45.92	7.469	62.29	46.38	7.38	62.75
Sobel		Z = 2.26, |Z| > 0.97			Z = 3.24, |Z| > 0.97			Z = 3.76, |Z| > 0.97	

Note(s): This table shows the results of female directors promoting water performance (Columns 1, 4 and 7), water performance promoting water information disclosure (Columns 3, 6 and 9) and water performance as a mediator variable between female directors and water information disclosure (Columns 1–9). The t-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***p < 0.01, **p < 0.05, *p < 0.1

Table 12.
Additional Test 2 and
Test 3

(*Gender_num*, *Gender_ratio* and *Gender_ind*) are positive and statistically significant (coef. 0.071, $P < 0.01$, coef. 0.499, $P < 0.01$, coef. 0.054, $P < 0.05$). These results suggest that female directors are not manipulating CSR reports to convey the impression of being environmentally or socially harmless by issuing CSR reports. As they actively publish environmental-related reports, most likely to address information asymmetry, female directors can indeed contribute to positive corporate water performance. This far, the "action" of female directors on water information disclosure has been supported.

Next, by verifying the relationship between water performance and water information disclosure, we further verify consistency of words and deeds of female directors on corporate voluntary nonfinancial information disclosure (i.e. water information disclosure). Empirical evidence in Columns (3), (6) and (9) in Table 12 demonstrates that the relationship between water performance and water disclosure is positive and significant (coef. 0.234, $P < 0.01$, coef. 0.234, $P < 0.01$, coef. 0.233, $P < 0.01$), indicating that companies with better water performance disclose more water information. Basically, female directors can not only promote corporate positive water information disclosure but also yield actual progress in water issues and promote better water performance to protect water resources. Therefore, female directors can promote environmentally friendly and green transformation of enterprises and do not publish nonfinancial information for "greenwashing." The consistency of words and deeds of female directors in water information disclosure has been verified.

6.3 The mechanism of female directors promote water disclosure
In the above research, we not only confirmed that female directors positively affect water information disclosure but also know that female directors can promote corporate water performance and, in turn, water information disclosure. We then expect that female directors can improve companies' water information disclosure by promoting better water performance, that is, water performance mediates the relationship between female directors and water information. To test this conjecture, we estimate the following model using Baron and Kenny's (1986) three-step method. The model of the first step is shown in Model (2):

$$Water\_performance_{i,t} = \alpha_0 + \alpha_1 \cdot Gender\_all_{i,t} + \alpha_2 \cdot Control_{i,t} + \varepsilon_{i,t} \qquad (4)$$

$$Water\_disclosure_{i,t} = \alpha_0 + \alpha_1 \cdot Gender\_all_{i,t} + \alpha_2 \cdot Water\_perfor_{i,t} + \alpha_3 \cdot Control_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $Water\_performance_{i,t}$ is the water performance index in the year t from the firm i; the number of female directors ($Gender\_num_{i,t}$), proportion of female directors ($Gender\_ratio_{i,t}$) and number of female independent directors ($Gende\_ind_{i,t}$) are represented by $Gender\_all_{i,t}$, and i denotes the individual corporation, t denotes the period and the error term is $\varepsilon_{i,t}$.

In the first step, we verified the relationship between water disclosure (the dependent variable) and female directors (the independent variable). The empirical results are presented in Columns (1), (4) and (7) of Table 12. As shown in Table 12, the coefficient of three proxies of female directors (*Gender_num*, *Gender_ratio* and *Gender_ind*) are positive and statistically significant (coef. 0.021, $P < 0.01$; coef. 0.167, $P < 0.05$; coef. 0.050, $P < 0.01$, respectively). In the second step, we verified the relationship between water performance (the mediating variable) and female directors. Columns (2), (5) and (8) of Table 12 present the empirical results. The coefficient of three proxies of female directors (*Gender_num*, *Gender_ratio* and *Gender_ind*) are positive and statistically significant (coef. 0.071, $P < 0.01$; coef. 0.499, $P < 0.01$; and coef. 0.054, $P < 0.05$, respectively). Finally, when the mediator variable is added to the basic model (Model 2), the regression coefficients of female directors are reduced to 0.019, 0.157 and 0.047, respectively. The significance level is also reduced. Simultaneously, in Model (5), the regression coefficients of water performance are positive and statistically significant (coef.

0.234, $P < 0.01$; coef. 0.234, $P < 0.01$; coef. 0.233, $P < 0.01$). Finally, the Sobel Z test values were 2.26, 3.24 and 3.76, respectively, and statistically significant at the 1% level. Because the coefficients of the three models' main variables are all significant, the coefficients of female directors become smaller when the mediator variable is added (coef. 0.021–0.019, coef. 0.167–0.157 and coef. 0.050–0.047), and the Sobel Z values were all statistically significant. Therefore, the correlation between female directors and water information disclosure is indirect, and water performance plays a partial mediating role, or it is only one of the factors influencing such a relationship. The overall findings confirm that female directors can facilitate water disclosure by improving the company's actual water performance.

7. Discussion, conclusion and further research

Our study serves three main purposes. First, we determine whether female directors have impact on nonfinancial disclosures (i.e. water information disclosure) and how their impact changes under pressure from directly related internal risks. Second, we evaluate how female directors affected corporate environmental performance and verify whether female directors are consistent in promoting green transformation. Finally, our third objective was to provide empirical evidence for promoting corporate green transformation and social green transformation.

Interestingly, our findings support the previously established relationship between board gender diversity and CSR disclosure. As we stated in the introduction, CSR information disclosure is a comprehensive indicator encompassing many dimensions, including responsibilities to employees, creditors, consumers and the environment. Although such comprehensive metrics are useful for measuring a company's overall environmental and social disclosures, they do not reveal whether and how specific types of disclosures are influenced by board gender diversity. According to Zeng, Zhang, Zhou, Zhao and Chen (2019), this situation exists because differences in companies' primary businesses may lead to their own preferences in the types of CSR disclosures, and the emphasis on different types of environmental disclosures is likely to differ. Previous research on the relationship between board gender diversity and CSR information disclosure supports this viewpoint. As can be seen, carbon information disclosure and water information disclosure are two distinct branches of CSR information disclosure. Simultaneously, as people's awareness of the importance of carbon dioxide hazards in recent years, countries around the world have successively issued corresponding policies (e.g. China's carbon neutrality and carbon peaking) to force companies to actively disclose carbon information. However, at present, people's awareness of the importance of water information disclosure is still far from sufficient (Liu *et al.*, 2021), and it is still classified as voluntary in China. Water disclosure research can better reflect the companies' reasons for voluntary nonfinancial disclosure. Therefore, our research is extremely important for companies and regulators to understand the drivers of specific types of environmental disclosures, allowing them to make more effective decisions in the future.

To explore how female directors affect corporate water disclosures (H1), we conducted a multiple regression analysis and performed the necessary robustness tests. As we anticipated, the results suggest a positive relationship between female directors and water information disclosure, and presence of female directors can promote corporate water disclosure behavior. Additionally, the results also show that when enterprises belong to high water-sensitive industries, promoting water information disclosure by female directors is more evident than that of enterprises belonging to low water-sensitive industries, which is consistent with our previous prediction (H2).

Furthermore, this study contributes to the critical mass theory by testing the impact of the number of female directors on water disclosures in our additional analyses. Our empirical results indicate that only when two or more female directors can be found in the enterprise

can there be substantial impact on the decision-making of corporate water information disclosure. This reveals a linear relationship between female directors and water information disclosure, which is similar to previous research results supporting the critical mass theory (McGuinness *et al.*, 2017; Jia & Zhang, 2013; Amorelli & García-Sánchez, 2021). However, unlike previous studies (Fernandez-Feijoo *et al.*, 2014; Ben-Amar *et al.*, 2015), we found that when more than four female directors were present, the level of significance between female directors and water information disclosure decreased. After excluding the U-shaped relationship, we believe this is likely because of the fact that as the proportion of female directors increases, they categorize themselves and others by gender and into both in-groups and out-groups (Nielsen & Huse, 2010; Pucheta-Martínez *et al.*, 2019; Terjesen *et al.*, 2009). Based on the social identity theory (Tajfel & Turner, 1986), individuals identify with their own group through social classification (such as gender) and generate in-group preference and out-group discrimination. Individuals increase their self-esteem by achieving or maintaining a positive social identity, manifested by a high evaluation of in-group members while discouraging out-group members from joining, and gender is one of the important criteria for social classification. Traditionally, these boards have been dominated by men, and not only are women likely to be viewed as out-group members, causing their efforts and contributions to be underestimated but the inclusion of female directors is considered a threat to men (Mackie, 1987). However, as the number of female directors increases, men need to share power with them. According to the social identity theory, this may intensify the differences and conflicts between the two gender groups, which in turn affects the rationality and performance of individual corporate decision and ultimately leads to negative results for the business (Pucheta-Martínez *et al.*, 2019).

Therefore, based on the above conclusions, we believe that the "double critical mass" view (Birindelli *et al.*, 2018) should be supported for water information disclosure. Hence, the board of directors should be composed of a balanced number of men and women. For Chinese companies, the number of female directors should preferably be greater than 2; less than six female directors are the most beneficial for companies to disclose nonfinancial information. This result contains important implications for managers, who should not only pay attention to gender diversity in the board of directors, but also consider the impact of the proportion of the number of people on the green transformation of enterprises.

In our study, we found that female directors follow through on environmental disclosures. By constructing water performance indicators, we empirically verify that female directors can not only discuss water issues (i.e. disclosure) but also do them (i.e. performance). This is an important finding for water disclosure research. For a long time, many companies have obtained illegitimate benefits by issuing "greenwashing" CSR reports, which has always been a gap affecting investors, consumers, regulators and other stakeholders to fully understand companies (Pope & Wæraas, 2016). The surge in greenwashing incidents could have a profound negative impact on consumer and investor confidence in corporate green claims (Gosselt *et al.*, 2019). However, in our study, we demonstrate that the contribution of female directors in promoting water disclosure is actually by promoting positive corporate water performance. We improve the validity of the application of the signaling theory in water disclosure research by providing new evidence. In the future, external stakeholders (e.g. investors, consumers, government departments, lenders and the general public) will increase their basis for judging the reliability of information and reduce information asymmetry when faced with information (e.g. gender diversity of the board of directors and corporate water information disclosure reports). Additionally, because female directors do improve water disclosure and water performance, this, in turn, leads to corporate contributions to green transformation in society. Therefore, among the many means of social green transformation, gender diversity on the board remains a significant measure worth consideration.
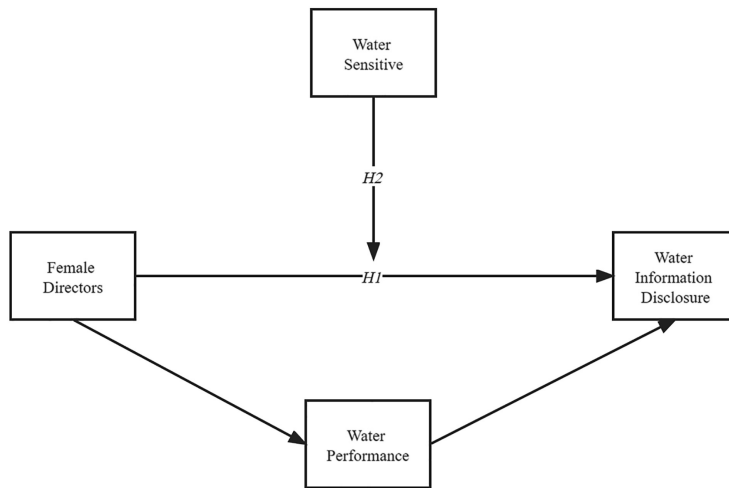
Figure 1.
Research framework

Overall, we believe that female directors can improve the consistency of words and deeds in nonfinancial information disclosure. Moreover, within a certain range, they can motivate companies to disclose more information about water and are influenced by internal risk pressures. Therefore, this study provides important contributions to both theory and practice. Figure 1 presents the research framework of our study. However, our study contains certain limitations. First, the study focuses on the number and proportion of female directors and does not consider the impact of the specific characteristics (e.g. education, experience, major and religiosity) of female directors on water disclosure. Previous studies have shown that the fault line of female directors will have impact on corporate CSR reporting (Ramon-Llorens, Garcia-Meca, & Pucheta-Martínez, 2020; Harjoto & Rossi, 2019). In the future, the influence of various characteristics of female directors on water information disclosure and water performance should be considered to make the research framework about water disclosure and female directors more complete. Second, our study is based on a Chinese sample. However, we believe our findings apply to countries consistent with the background of Chinese women (historically underserved, but feminism is prevalent in modern times and a minority on boardrooms). Owing to differences in political situations, legal systems and cultures, we recommend that future research supplement research samples from more countries to clarify the role of female directors in water disclosure. Third, as the current exploration of water information disclosure remains in its infancy, and there is less research on water performance, although we have paid attention to these issues, measurement of water performance in this study is based on the study of carbon performance and remains in the exploratory stage. In future research, more attention should be paid to water information disclosure and water performance, and more research is necessary for formulating a comprehensive and objective set of mature water performance evaluation criteria.

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Further reading

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Appendix 1

Variables	Description	Data source
Independent variables		
Gender_num	The number of female directors on board	CSMAR
Gender_ratio	Proportion of female directors on board	CSMAR
Gender_ind	The number of independent female directors on board	CSMAR
Dependent variables		
Water_dummy	The dummy variable, equal to 1 if the enterprise disclosure water information and 0 otherwise	Liu *et al.* (2021)
Water_disclosure	The natural logarithm of corporate water information disclosure index score plus one	Liu *et al.* (2021)
Moderating variables		
Water_sensitive	The dummy variable, 1 if the enterprise belongs to low water-sensitive industries and 0 if otherwise	CSRC (2012)
Control variables		
Size	The natural logarithm of total assets	CSMAR
Lev	Leverage and total liabilities/total assets	CSMAR
Roa	Return on assets, earnings before interest and taxes/total assets	CSMAR
SOE	The dummy variable, equal to 1 if the enterprise is state owned and 0 if otherwise	CSMAR
Dual	The dummy variable, equal to 1 if the CEO is also the board chairperson and 0 if otherwise	CSMAR
Board	Board size and natural logarithm of the total number of board members	CSMAR
Tobin's Q	The ratio of the market value of a firm's asset/the replacement cost of the firm's assets	CSMAR
Age	The natural logarithm of the sum of the age of the firm listed plus one	CSMAR
Year	Year dummy variables	CSMAR
Industry	Industry dummy variables	CSMAR
Other variables		
Gender_blau	The Blau (1977) Index of heterogeneity. $Blau = 1 - \sum_{i=1}^{2} P_i^2$, where $i =$ (1, 2) for the number of gender categories (i.e. male and female) and P is the proportion for each category (male or female) on the board	CSMAR
L_Gender	The number of female directors in one lag period	CSMAR
Aver_Gender	The average number of female directors in the same industry in the same period	CSMAR
Gender	The dummy variable, equal to 1 if there are female directors in the company and 0 if otherwise	CSMAR

(*continued*)

Table A1.
Variable definitions

Variables	Description	Data source
HHI	Herfindahl–Hirschman Index, $HHI = \sum_{i=1}^{N}\left(\frac{S}{S}\right)^2$, where $\frac{S}{S}$ is the ratio of the company's operating income to the total revenue	CSMAR
OwnershipConcentration	The percentage of total shares owned by top five shareholders	CSMAR
Inter_control	DIB Database internal control score	DIB
Media	The total number of corporate reports on the Internet and in the press	CNRDS
Beta	$\beta_a = \frac{Cov(r_a, r_m)}{\sigma_m^2}$, where r_a is company stock, r_m is stock return and σ_m^2 is variance of market returns	CSMAR
Water_perfor	The water performance index, with a score of 0–5	Luo and Tang (2021)

Note(s): CSMAR: China Stock Market and Accounting Research Database. DIB: Dibo database. CNRDS: Chinese Research Data Services. China Securities Regulatory Commission (CSRC)

Table A1.

Appendix 2

Quantitative			Qualitative	
Water use (*wu*) (0–4 score)	Wastewater discharge (*wd*) (0–4 score)	Wastewater reuse (*wr*) (0–4 score)	Water-related reward (*wrr*) (0–4 score)	Water-related punishment (*wrp*) (0–4 score)
Equal to 1 if water consumption is lower than the previous year and 0 if otherwise	Equal to 1 if wastewater discharge is lower than the previous year and 0 if otherwise	$100\% \geq wr$ >75%: 4 score	International level rewards: 4 score	Cancellation of business license/market Ban: 4 score
Equal to 1 if (water consumption/current year's operating income) is lower than the previous year and 0 if otherwise	Equal to 1 if (displacement/total sales revenue for the year) is lower than the previous year and 0 if otherwise	$75\% \geq wr$ >50%: 3 score	National level awards: 3 score	Fine: 3 score
Equal to 1 if water usage is less than the median water usage in the industry and 0 if otherwise	Equal to 1 if displacement is less than the median displacement in the industry and 0 if otherwise	$50\% \geq wr >$ 25%: 2 score	Provincial level rewards: 2 score	Warning/condemnation: 2 score
Equal to 1 if (water consumption/total sales revenue for the year) is lower than the median of the industry's (water consumption/total sales revenue for the year) and 0 if otherwise	Equal to 1 if (displacement volume/total sales revenue for the year) is lower than the median of the industry's (displacement volume/total sales revenue for the year) and 0 if otherwise	$25\% \geq wr >$ 0%: 1 score	City level and below rewards: 1 score	Criticize: 1 score
		$wr = 0$: 0 score	No reward: 0 score	No punishment: 0 score

Note(s): The final score for water performance = (*wu* + *wd* + *wr* + *wrr-wrp*)/*water risk*, where *wu* denotes water use, *wd* denotes wastewater discharge, *wr* denotes wastewater reuse, *wrr* denotes water-related reward, *wrp* denotes water-related punishment and *water risk* denotes the water risk index of the basin to which the company's actual geographic location belongs

Table A2.
Water performance index

Appendix 3

| Variable | Gender | |
	(1)	(2)
L_Gender	7.251*** (196.107)	
Aver_Gender		0.849*** (21.691)
Size	0.018*** (3.633)	−0.048*** (−5.524)
Lev	0.054** (1.984)	0.081* (1.697)
Roa	0.096 (1.153)	0.263* (1.785)
SOE	0.035*** (−3.226)	−0.102*** (−5.280)
Dual	0.012* (1.090)	0.074*** (4.020)
Board	−2.060*** (−24.609)	−2.047*** (−14.072)
Tobin's Q	−0.001* (−0.203)	−0.016** (−2.373)
Age	−0.079*** (−11.063)	−0.251*** (−22.916)
Constant	0.987*** (4.622)	2.392*** (7.406)
Year	Yes	Yes
Industry	Yes	Yes
Obs	7,099	7,099
Adj-R^2	0.663	0.107
F	1,142	74.72

Note(s): The regression results for the first step of Heckman's two-stage analysis are presented in this table. *L_Gender* denotes the number of female directors in one lag period, whereas *Aver_Gender* is the number of female directors in the same industry in the same period. *Gender* is a dummy variable that equal to 1 if there are female directors in the company and 0 if otherwise. The *t*-values are given in parentheses next to the coefficients. All variables are defined in Appendix 1. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table A3.
The first stage
regression results of
Heckman's two-
stage model

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