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The Impact of Climate Risk on Corporate Water Disclosure: Evidence from Water Intensive Companies in Indonesia

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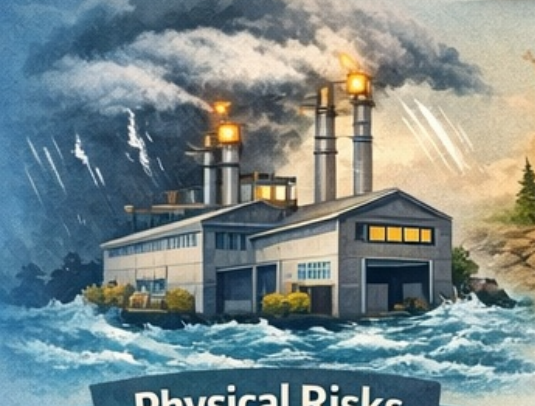
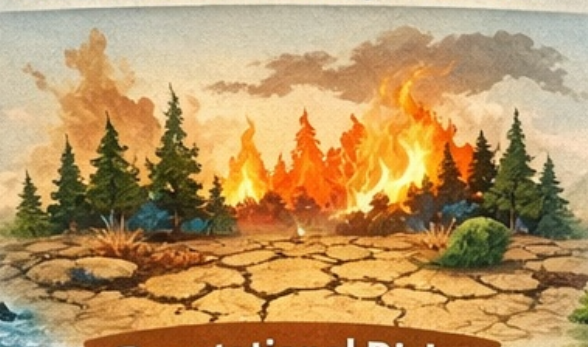
780 Firm-Year Observations

2021–2023 Study Period



Physical Risks



Reputational Risks

Regulatory Risks

Corporate Water Disclosure in Indonesia

Increased Disclosure

Physical & Reputational Risks

Water Efficiency Targets

Water Policies

Total Water Withdrawal

Reduced Disclosure

Regulatory Risks

Larger Companies

Higher CWD Levels

Symbolic Reporting

Strict Regulations

Transparency & Sustainable Water Management

Highlights of Sustainability

Article

The Impact of Climate Risk on Corporate Water Disclosure: Evidence from Water Intensive Companies in Indonesia

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Abstract This study examines the impact of climate-related risks—specifically, physical, regulatory, and reputational risks—on corporate water disclosure (CWD) in water-intensive industries in Indonesia, one of the countries most vulnerable to the impacts of climate change. Grounded in legitimacy theory, the research explores how companies enhance transparency in water management to maintain social acceptance amid external pressures. Using 780 firm-year observations from sustainability and annual reports covering 2021–2023, this study developed the CWD index based on three leading indicators: water efficiency targets, policies, and total water withdrawal. The regression results show that physical and reputational risks positively and significantly impact the level of water disclosure. Firms experiencing operational disruptions or reputational pressure tend to enhance their disclosure efforts to sustain legitimacy. On the other hand, regulatory risk shows a significant negative relationship with disclosure, suggesting that stringent regulations may lead to symbolic rather than substantive reporting. Company size was also found to be the strongest predictor of water disclosure, affirming that larger companies have greater capacity and pressure for sustainability reporting. This research provides a theoretical contribution by integrating the climate risk dimension into sustainability disclosure studies and a practical contribution for regulators. These findings highlight the need for incentive-based regulatory frameworks encouraging genuine corporate transparency and sustainable water management practices.

Keywords climate risk; corporate water disclosure; water-intensive industry; physical risk; regulatory risk; reputational risk

1. Introduction

Climate change has become a global driver of financial and non-financial reporting transformation, particularly regarding water resource management. Across regions such as Europe, North America, and East Asia, corporations are increasingly required to disclose water-related information as part of broader climate-risk reporting frameworks, including the Task Force on Climate-related Financial Disclosures (TCFD) and Global Reporting Initiative (GRI 303: Water and Effluents). These initiatives underscore that water scarcity and climate-related water risks are no longer local environmental issues but global economic concerns that affect investor confidence, regulatory compliance, and corporate reputation.

Against this global backdrop, Indonesia faces significant challenges due to climate change affecting the availability and quality of water. The risks of climate change—physical, regulatory, and reputational—have become crucial factors in managing corporate water resources [1]. However, research on the relationship between these risks and corporate water disclosure in Indonesia remains limited. Grounded in legitimacy theory, firms may use disclosure as a means to maintain social acceptance amid climate-related challenges, illustrating how external pressures influence transparency in corporate behavior [2]. Legitimacy theory is especially appropriate for this study because climate-related pressures heighten societal expectations for responsible water management, making corporate disclosure a strategic response for maintaining organizational legitimacy.

Physical, regulatory, and reputational risks represent distinct yet interconnected dimensions of climate risk. Physical risk refers to threats such as droughts, floods, and water scarcity that disrupt operations and supply chains; regulatory risk involves tightening environmental laws and policy uncertainty; while reputational risk emerges from public scrutiny and negative sentiment over environmental performance. Together, these risks shape corporate strategies in water

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management and reporting practices. Companies in Indonesia face increasing pressure to ensure operational sustainability in water-intensive sectors, where the balance between environmental responsibility and business continuity is particularly fragile.

Climate change poses significant risks to companies, especially those related to water resources. These risks include physical, regulatory, and reputational challenges that affect the company's operations and financial performance. Regarding physical risks, climate change exacerbates water scarcity, flooding, and pollution, disrupting business operations and supply chains [3–5]. The increasing frequency and severity of extreme weather events, such as storms and droughts, heighten water-related risks [6]. Climate change also forces companies to face regulatory risks, where they encounter strict regulations aimed at reducing the impact of climate change, which can lead to increased compliance costs and potential litigation [5]. Companies also face reputational risks. Failure to adequately disclose and manage water risks can damage the company's reputation, affecting investor and stakeholder trust [2,7,8].

Building on this understanding, corporate water disclosure (CWD) refers to companies' voluntary or mandatory communication of information about water usage, management, and related impacts. Transparency in this domain strengthens stakeholder trust and corporate legitimacy, especially under climate stress. Yet, many firms continue to underreport water-related information due to uncertainty and limited awareness of the materiality of water risks. This gap highlights the need for deeper exploration into how different types of climate risk affect disclosure behavior.

Previous studies have not simultaneously examined these three risk dimensions—physical, regulatory, and reputational—within a developing country context like Indonesia. Existing research often focuses on general sustainability disclosure or on evidence from developed economies such as the US and Europe. Therefore, this study contributes to the sustainability disclosure literature by analyzing climate risks and their effects on water-related disclosure in a context highly vulnerable to climate impacts.

This research makes several contributions. From a theoretical perspective, it extends legitimacy theory by incorporating climate-related risks as external legitimacy pressures influencing corporate disclosure behavior. From a practical perspective, it provides insights for policymakers and industry practitioners to design incentive-based regulatory frameworks that encourage genuine corporate transparency in water reporting.

The remainder of this paper is organized as follows: Section 2 presents the theoretical framework and literature review; Section 3 explains the research methodology; Section 4 discusses the findings and analysis; and Section 5 concludes with implications and future research directions.

2. Theory and Literature Review

This study uses legitimacy theory as a theoretical framework to explain the impact of climate risk on corporate water disclosure. The theory of legitimacy posits that organizations operate to fulfil economic goals and obtain and maintain legitimacy from the society in which they operate [9]. Legitimacy theory explains how companies strive to gain approval from society and stakeholders by aligning their operations and reporting with social and environmental norms [10]. In this context, legitimacy is viewed as the perception or assumption that the company's actions are acceptable and desirable and follow the broader social system's norms, values, and beliefs.

Climate-related events heighten public scrutiny and intensify legitimacy pressures, prompting firms to use disclosure as a strategic response to demonstrate accountability and environmental responsibility. Thus, climate risk functions as a legitimacy trigger that influences corporate transparency behavior [11,12]. Disclosure of environmental information, including water disclosure, becomes a mechanism through which firms manage legitimacy when facing external threats such as physical disruptions, regulatory interventions, and reputational challenges. Based on this perspective, the following hypotheses are developed.

2.1. Physical Risk and Corporate Water Disclosure

Physical risk refers to the tangible impacts of climate change—such as droughts, floods, or declining water quality—that threaten company operations and continuity. Firms facing greater physical risk tend to increase their disclosure of water-related information to demonstrate operational resilience and commitment to sustainable resource management [3,4]. From a legitimacy perspective, such transparency verifies to stakeholders that the company can responsibly manage

environmental challenges. This behavior aligns with the findings of previous research showing that disclosure helps mitigate reputational damage and strengthen stakeholder confidence [13–15].

H1: Physical risks due to climate change positively affect the level of corporate's Corporate Water Disclosure.

2.2. Regulatory Risk and Corporate Water Disclosure

Regulatory risk arises when firms face stricter or uncertain environmental regulations, encouraging them to disclose water-related information more proactively to demonstrate compliance and maintain legitimacy [5,16].

Research by Meutia et al. [16] and Ben-Amar & Chelli [17] demonstrate that disclosure of climate and environmental information can serve as a proactive response to institutional pressure. Similarly, Dienes et al. [15] find that increased regulatory attention to physical and transition risks enhances corporate disclosure transparency. While excessive regulation may limit voluntary reporting in some contexts, this study focuses on the prevailing expectation that regulatory risk increases disclosure as firms seek legitimacy.

H2: Regulatory risk related to climate change positively affects the level of corporate's Corporate Water Disclosure.

2.3. Reputational Risk and Corporate Water Disclosure

Reputational risk arises when firms face negative public perception or environmental controversies, prompting them to increase transparency to demonstrate accountability and maintain legitimacy. In line with legitimacy theory, such reputational pressures encourage firms to use disclosure as a mechanism to repair stakeholder trust and protect their corporate image.

Empirical studies support this mechanism. Ben-Amar & Chelli [17] show that companies striving to protect their reputation are more proactive in disclosing water-related information and sustainability initiatives. Likewise, Flammer et al. [11] emphasize that voluntary environmental disclosure mitigates reputational losses arising from public scrutiny. Therefore, companies experiencing reputational pressure are more likely to provide comprehensive corporate water disclosure as a form of perception management and social accountability.

H3: The reputational risk due to climate change positively affects the level of corporate water disclosure by the company.

2.4. Control Variable: Firm Size

In addition to these three risk dimensions, this study includes firm size (measured by total assets) as a control variable. Larger companies face stronger legitimacy pressure due to higher stakeholder visibility and regulatory attention. As a result, they are more likely to disclose detailed sustainability information, including water-related issues, to preserve their social license to operate [18,19].

3. Research Method

The object of this research is all water-sensitive companies in Indonesia listed on the Indonesia Stock Exchange (IDX). The water-sensitive industry category is based on the United Nations Environment Program (UNEP). The population comprises all companies registered in Indonesia's water-sensitive industry from 2021 to 2023. Based on the data, 260 companies listed on the IDX fall into the category of water-sensitive industries. After excluding companies with incomplete data on water disclosure, climate risk, or financial variables, the final sample consisted of 780 firm-year observations.

Data for this study were obtained from multiple sources to ensure reliability and triangulation. Corporate water disclosure was collected from annual and sustainability reports published on company websites and IDX filings. Climate risk data—including physical, regulatory, and reputational risks—were drawn from the Refinitiv ESG database and the World Resources Institute (WRI) Water Risk Atlas (https://www.wri.org). Financial and firm size data were obtained from audited financial statements available through IDX. Data collection for all variables was conducted between January and August 2024 to ensure consistency and comparability across sources.

3.1. Sample Distribution

Table 1 presents the distribution of companies by industry classification under water-sensitive categories.

Table 1. Number of companies by type of water-sensitive industry.

No	Industry	Company
1	Beverage	7
2	Chemical	23
3	Food Products	77
4	Containers & Packaging	19
5	Construction Materials	9
6	Metals & Mining	32
7	Oil, Gas & Consumable Fuels	44
8	Paper & Forest Products	11
9	Pharmaceuticals	10
10	Textiles, Apparel & Luxury Goods	24
11	Tobacco	4
	TOTAL	**260**

3.2. Variables and Measurement

The study used one dependent variable—CWD—and three independent variables: Physical Risk (PHY_R), Regulatory Risk (REG_R), and Reputational Risk (REP_R), with Firm Size (SIZE) as a control variable. The regression model employed is as follows:

$$CWD_{it} = \alpha + \beta_0 PHY\_R_{it} + \beta_1 REG\_R_{it} + \beta_2 REP\_R_{it} + \beta_3 SIZE_{it} + \varepsilon_{it}.$$

All variables were measured consistently across the 2021–2023 period and analyzed using panel data techniques. The definition and measurement of variables are described in Table 2.

Table 2. Research variables.

Code		Definition	Measurement
	Dependent Variable		
CWD	Corporate water disclosure	Disclosure about the company's water policies and usage	Measured using the company's water-related disclosures: water efficiency targets, policy, and total water withdrawal.
	Independent Variables		
PHY	Physical risk	Disclosure about the exposure to physical risk of the company	Does the company disclose the financial impact of physical risk? Using data from Refinitiv, specifically data on financial exposure to physical risk. Measured with a dummy: 1 = Yes; 0 = No.
REG	Regulation risk	Risks associated with uncertainty in regulatory changes.	Using data from the water risk atlas (https://www.wri.org) 1. low-medium, 2. medium-high, 3. high, 4. extremely high.
REP	Reputation risk	Risks related to climate change that will impact the company's reputation.	Measured with a dummy 1: The company discloses the existence of environmental controversies related to the company; 0: no.
	Control Variable		
SIZE	Company size	Total asset	Log natural Total Asset

3.2.1. Dependent Variable

The *CWD* index measures a company's disclosure of water efficiency targets, policies, and total water withdrawal. Each indicator was scored using a binary approach (1 = disclosed; 0 =

not disclosed), resulting in an index ranging from 0 to 3, then normalized to a scale of 0–1. This measurement follows the approach of Morris et al. (2023) [20]. The disclosure index and measurement are explained in Table 3.

Table 3. Corporate water disclosure index.

Number of Disclosures	Index	Disclosure Category
None	0	No
One out of three indicators	33.3 per cent (0.33)	Low
Two out of three indicators	66.7 per cent (0.67)	Medium
Three out of three indicators	100 per cent (1.00)	High

3.2.2. Independent Variables

Physical Risk refers to exposure to physical threats from climate change, such as droughts, floods, or disruptions in water supply. This variable was derived from the "Physical Risk (Quantity)" indicator of the WRI Aqueduct and complemented by Refinitiv ESG data on financial exposure to physical risks. It was measured as a dummy (1 = company discloses physical risk exposure; 0 = otherwise).

Regulatory Risk represents risks associated with uncertainty in water-related regulations. Data were sourced from the WRI Water Risk Atlas (2024), which classifies regions by regulatory intensity:

$$1 = \text{Low} - \text{Medium},\ 2 = \text{Medium} - \text{High},\ 3 = \text{High},\ 4 = \text{Extremely High}.$$

Higher scores indicate stricter regulatory environments.

Physical risk was coded as a dummy variable because Refinitiv reports firms' exposure to physical climate risks in binary form (1 = disclosed; 0 = not disclosed), whereas regulatory risk was measured using the ordinal scale provided by the WRI Water Risk Atlas, which classifies regulatory intensity into four levels from low-medium to extremely high.

Reputational Risk indicates whether a company was involved in environmental controversies, protests, or negative public sentiment related to water management. This information was extracted from Refinitiv ESG's "Environmental Controversy" indicator and verified through public media checks. It was coded as a dummy variable (1 = existence of controversy; 0 = none).

3.2.3. Control Variable

Firm Size is measured as the natural logarithm of total assets. Consistent with legitimacy theory, larger firms are expected to disclose more sustainability information because they face higher stakeholder visibility and legitimacy pressure [19,20].

3.3. Data Analysis

Data were analyzed using descriptive statistics and multiple regression analysis to examine the influence of climate risks on corporate water disclosure. Since the dataset consists of panel data (780 firm-year observations), both fixed and random effects models were estimated, and the Hausman test was applied to determine the most appropriate model. Diagnostic tests for multicollinearity, heteroscedasticity, and autocorrelation were performed to ensure model validity. To address potential heteroscedasticity and autocorrelation issues in the panel regression, we applied Huber–White robust standard errors to ensure the reliability of the coefficient estimates. Variance Inflation Factor (VIF) values were below the threshold of 10, indicating no multicollinearity issue.

4. Findings and Discussion

4.1. Descriptive Statistics of the Sample

As shown in Table 4, most sampled companies belong to the construction materials (29.6%), oil and gas (16.9%), and metals and mining (12.3%) sectors. UNEP classified these industries as water-intensive, making them highly relevant to this study. This concentration confirms that the analysis captures firms most exposed to climate-related water risks in Indonesia.

Table 4. Sample companies.

Industry	Frequency	Percent
Beverage	21	2.7
Chemical	69	8.8
Food Products	24	3.1
Containers & Packaging	57	7.3
Construction Materials	231	29.6
Metals & Mining	96	12.3
Oil, Gas & Consumable Fuels	132	16.9
Paper & Forest Products	33	4.2
Pharmaceuticals	30	3.8
Textiles, Apparel & Luxury Goods	72	9.2
Tobacco	15	1.9
Total	**780**	**100.0**

4.2. Distribution of Climate Risk Indicators

Table 5 presents the distribution of companies according to reputational, physical, and regulatory risks. Only 0.4% of firms reported reputational risks, and 1.2% acknowledged exposure to physical risks. In contrast, over 80% of firms were classified as operating under high or extremely high regulatory risk.

Table 5. Sample distribution based on reputation risk, physical risk, and regulation risk.

	Frequency	Percent
Reputation Risk		
No	777	99.6
Yes	3	0.4
Total	780	100.0
Physical Risk		
No	771	98.8
Yes	9	1.2
Total	780	100.0
Regulation Risk		
Medium	105	13.5
High	633	81.2
Extreme High	42	5.4
Total	780	100.0

This pattern reveals a striking under-recognition of reputational and physical risks in Indonesia's corporate reporting practices. Despite Indonesia's geographical vulnerability to floods and droughts, firms rarely disclose these risks, suggesting limited awareness or reluctance to expose vulnerabilities publicly. From a legitimacy perspective, this behavior can be interpreted as symbolic legitimacy maintenance, where companies prioritize positive image management rather than full transparency [13,17,21–23].

Furthermore, the practices observed in the Indonesian corporate landscape may resonate with broader global trends, as evidenced by studies indicating that companies in carbon-intensive industries often employ similar strategies to avoid public scrutiny regarding their environmental impact. Limited transparency undermines public trust and may affect investor relations, as capital markets increasingly prioritize firms that demonstrate accountability and ethical governance in their climate risk management strategies [14].

Table 5 also shows that only 9 out of 780 companies (1.2%) reported exposure to physical risks due to climate change (floods, droughts, or water supply disruptions). However, Indonesia is geographically a country that is very vulnerable to hydrometeorological disasters. These findings indicate a gap between the reality of environmental risks and the perception/willingness of companies to report them. Many companies may face physical risks but do not formally identify

them, or do not yet have adequate climate-based risk management systems to report them. This is consistent with the findings of prior studies [14,24]. This notes that institutional unpreparedness and a lack of climate analysis capacity hinder the systematic reporting of physical risks, especially in developing countries.

This phenomenon can be partly explained through the lens of legitimacy theory, which suggests that companies may avoid disclosing negative information that could threaten their legitimacy and market position. Rather than engaging in transparent reporting and openly discussing their vulnerabilities, these firms might shield themselves from scrutiny by minimizing or neglecting to identify such risks [25,26]. This viewpoint is supported by the premise that shareholder pressures often drive corporate behavior regarding disclosure. Without a strong impetus from stakeholders, firms may remain reticent about revealing significant risks.

As many as 81.2% of companies face high regulatory risk, and 5.4% of others fall into the extremely high regulatory risk category. This data shows that geographically, most companies are located in areas with high water regulation pressure according to the Water Risk Atlas classification. Although most companies face high regulatory pressure, the results of correlation and regression indicate that regulation does not positively affect water information transparency. There is a negative tendency, which can be interpreted as a defensive strategy by companies when facing uncertainty or the complexity of environmental policies. This indicates the need for regulatory transformation to be more empowering, not intimidating, in line with the recommendations [5].

4.3. Corporate Water Disclosure Patterns

Furthermore, the company's water information disclosure pattern is shown in Table 6. According to Table 6, 90% of firms disclosed no water information, while only 2.8% fully disclosed all three indicators (water efficiency targets, water policies, and total water withdrawal).

Table 6. Corporate water disclosure.

Disclosure	Frequency	Percent
No	702	90.0
Low	3	0.4
Medium	53	6.8
High	22	2.8
Total	780	100.0

These findings reinforce previous literature [19,27]. This states that water disclosure in developing countries, including Indonesia, is still very low. These findings are consistent with the study by Meutia et al. [28], which noted that disclosing water-related information in developing countries, including Indonesia, is still minimal. This reinforces the argument that water disclosure has not yet become common in corporate sustainability reporting.

This fact also underscores the importance of this research in filling the literature gap. The high proportion of companies that do not disclose water information at all (90%) is a strong signal that water disclosure has not yet become a common practice or priority in the sustainability reporting of Indonesian companies. This is also in line with the findings of Jaiswal et al. [27]. This suggests that sustainability reports still prioritize water issues less than carbon and energy. According to legitimacy theory [9], low disclosure may reflect that companies do not yet feel water issues threaten their social legitimacy, or that external pressures (regulators, investors, society) regarding water issues are still not strong enough to drive changes in reporting behavior. Descriptive statistics for each research variable are shown in Table 7, consisting of minimum, maximum, mean, and standard deviation (SD) values.

The average value of the Water Disclosure Index of 0.075 confirms that most companies in the sample do not disclose water information. This indicates that the disclosure regarding water issues is minimal, which can create gaps in transparency and the company's understanding of existing risks. A study by Huiskamp et al. [4] shows that the low water disclosure in Indonesia reflects the challenges companies face in managing and reporting important information to stakeholders.

The very low average Reputation Risk value of 0.0038 indicates that only a few companies acknowledge or report controversies and social pressures related to water issues that could

damage their image. These findings align with research indicating that companies often avoid disclosing non-financial information, including reputational risks, to maintain their image before the public and stakeholders [29]. Additionally, the low recognition of physical risks, with an average value of 0.0115, indicates that companies overlook risks such as floods and droughts that can impact their operations. This is surprising considering Indonesia is vulnerable to climate change and extreme weather events [30].

The lack of recognition of these physical risks may indicate a company's risk management capacity deficiency or the absence of formal mechanisms documenting physical risk assessments in their reports [26]. This is relevant to findings that show a lower focus on water-related risks than regulatory risks, which have an average value of 2.92. This indicates that companies prefer to emphasize compliance with regulations rather than acknowledging risks that could damage their reputation and operations [27]. According to Jaiswal et al. [27], attention to water issues still lags behind carbon and energy issues in sustainability reports, emphasizing that water disclosure has not yet become a priority for many companies.

Table 7. Descriptive statistics variables.

Variables	N	Minimum	Maximum	Mean	SD
Industry	780	1.00	11.00	5.8115	2.35961
Reputation Risk	780	0.00	1.00	0.0038	0.06194
Physical Risk	780	0.00	1.00	0.0115	0.10686
Regulation Risk	780	2.00	4.00	2.9192	0.42682
Company Size	780	13.82	23.21	18.4606	1.81905
Corporate Water Disclosure	780	0.00	1.00	0.0750	0.23145
Valid N (listwise)	780				

4.4. Correlation and Regression Analysis

As presented in Tables 8 and 9, the results of correlation and regression analyses show three key relationships: Physical risk has a positive and significant association with corporate water disclosure ($\beta = 0.298$, $p < 0.001$); Reputational risk also shows a positive and significant effect ($\beta = 0.199$, $p < 0.001$); Regulatory risk, however, has a negative and significant impact on disclosure ($\beta = -0.060$, $p = 0.048$).

The finding that reputation risk shows a positive and significant correlation with water disclosure ($r = 0.189$, $p < 0.01$) supports hypothesis H3, suggesting that companies facing or anticipating reputational impacts due to environmental issues tend to be more open in reporting water information. These findings are consistent with legitimacy theory, which emphasizes the importance of acknowledging social and environmental issues to maintain public support and the legitimacy of corporate operations. Research by Andersson & Arvidsson [2] proves that companies with higher reputational risk are more likely to increase their disclosure of environmental information, including water issues, to improve their public image.

Physical risk has a stronger positive correlation ($r = 0.346$, $p < 0.01$) than reputational risk. This correlation indicates that companies facing the direct impacts of climate change, such as droughts, floods, or water supply instability, are more inclined to be transparent in water reporting. This supports hypothesis H1 and indicates that threats to operational continuity have a strong driving force on reporting practices. On the contrary, regulatory risk shows a negative but significant correlation with corporate water disclosure ($r = -0.073$, $p < 0.05$). These results contradict hypothesis H2 and previous literature findings such as (5.17) [5,17]. This emphasizes that regulatory pressure should encourage transparency. This negative correlation indicates that strict regulations might encourage defensive disclosure strategies or make companies unprepared to meet higher reporting expectations.

Company size strongly correlates with water disclosure ($r = 0.393$, $p < 0.01$). This confirms that companies with significant assets are more likely to have sound sustainability reporting systems and resource capacity for climate risk management, and they are under the spotlight of regulators and investors. These findings are consistent with the role of company size as a significant control variable in many studies [18].

Meanwhile, the type of industry does not show a significant relationship ($r = 0.015$, $p = 0.675$), indicating that the business sector does not solely determine corporate water disclosure. Although the water-intensive sector was chosen as the population, differences in reporting practices are

more defined by the company's internal characteristics and perceptions of climate risk rather than by its industry classification.

Table 8. Correlations analysis.

	Corporate Water Disclosure	Industry	Reputation Risk	Physical Risk	Regulation Risk	Company Size
Corporate Water Disclosure	1					
Industry	0.015	1				
Reputation Risk	0.189**	0.014	1			
Physical Risk	0.346**	−0.017	−0.007	1		
Regulation Risk	−0.073*	0.023	0.012	0.020	1	
Company Size	0.393**	0.003	−0.020	0.146**	−0.061	1

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 9. Regression analysis.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	SD Error	Beta		
(Constant)	−0.661	0.090		−7.361	0.000
Reputation Risk	0.744	0.114	0.199	6.545	0.000
Physical Risk	0.645	0.067	0.298	9.683	0.000
Regulation Risk	−0.033	0.017	−0.060	−1.978	0.048
Company Size	0.044	0.004	0.349	11.336	0.000

Next, Table 10 above summarizes the research findings based on the results of statistical tests for each hypothesis. These findings indicate that water disclosure in Indonesia remains very limited, and firms generally respond to climate-related pressures by adjusting their transparency in line with legitimacy expectations. Physical and reputational risks encourage substantive disclosure because operational disruptions and reputational pressures heighten stakeholder scrutiny, while regulatory risk shows a negative relationship, suggesting that stringent or uncertain regulations may trigger symbolic rather than proactive reporting. This pattern is consistent with prior research showing that firms in developing countries tend to adopt selective disclosure strategies when facing compliance pressure and limited institutional capacity.

Table 10. Summary of hypotheses and statistical results.

Hypothesis	Expected Relationship	Correlation Result	Regression Result	Conclusion
H1: Physical risk → CWD	Positive	$r = 0.346$, $p < 0.01$	$\beta = 0.298$, $p < 0.001$	Supported
H2: Regulatory risk → CWD	Positive	$r = -0.073$, $p < 0.05$	$\beta = -0.060$, $p = 0.048$	Not Supported (significant but negative)
H3: Reputational risk → CWD	Positive	$r = 0.189$, $p < 0.01$	$\beta = 0.199$, $p < 0.001$	Supported

The regression coefficient shows that reputation risk positively and significantly affects water disclosure ($\beta = 0.199$, $p < 0.001$), supporting hypothesis H3. These results confirm the critical role of social pressure in driving corporate transparency behavior. In line with previous views [2,21], companies strive to mitigate reputational crises by increasing information transparency, particularly regarding sensitive issues like water.

Meanwhile, the size of the company (log of assets) has the most significant influence on disclosure ($\beta = 0.349$, $p < 0.001$), indicating that larger companies are more capable and more motivated to report sustainability [18]. This supports the function of the SIZE control variable in the model while also reinforcing the relevance of the legitimacy theory, which states that larger entities are under greater public scrutiny and higher regulatory pressure.

4.5. Discussion and Theoretical Implications

The results collectively reveal how firms in Indonesia adopt different legitimacy management strategies in response to distinct types of climate risks, as shown in Table 11.

Table 11. Mapping risks type.

Risk Type	Legitimacy Mechanism	Disclosure Behavior
Physical Risk	Operational legitimacy: demonstrating resilience and responsibility	Substantive disclosure (proactive reporting on water use and efficiency)
Regulatory Risk	Regulatory legitimacy: compliance justification under policy pressure	Symbolic disclosure or avoidance when regulation feels coercive
Reputational Risk	Social legitimacy: managing image and trust	Selective transparency to rebuild or maintain stakeholder confidence

These patterns demonstrate that legitimacy responses are context-specific rather than uniform.

While physical and reputational risks encourage disclosure as a form of proactive legitimacy management, regulatory risk suppresses transparency when firms perceive rules as threatening rather than supportive. In the Indonesian setting, weak enforcement and limited stakeholder activism may encourage symbolic responses rather than genuine transparency [24,30]. This underscores the need for a regulatory approach that combines incentives with guidance—fostering cooperation rather than compliance anxiety.

4.6. Policy and Practical Implications

From a policy standpoint, the findings suggest that Indonesian regulators should prioritize incentive-based frameworks—for instance, rewarding firms that integrate water-related indicators in sustainability reports rather than relying solely on sanctions. From a corporate perspective, firms should strengthen internal risk management systems and incorporate water metrics into broader ESG reporting frameworks to align with global sustainability standards [26,27]. Civil society and investors can also play a critical role by increasing public awareness and monitoring corporate transparency, thereby amplifying legitimacy pressures that encourage substantive rather than symbolic reporting. These findings suggest the need for regulatory approaches that not only strengthen corporate accountability but also align with global sustainability frameworks such as GRI 303 (Water and Effluents) and TCFD, which emphasize transparent disclosure of water-related risks and climate resilience strategies.

Overall, the results demonstrate that while physical and reputational risks positively influence corporate water disclosure, regulatory risk discourages transparency. This asymmetry highlights how legitimacy management among Indonesian firms reflects strategic and adaptive behavior. Firms appear to balance symbolic compliance (to satisfy formal expectations) and substantive accountability (to sustain social legitimacy), depending on the nature of the threat. Therefore, future sustainability governance should aim to transform regulatory legitimacy—from a compliance-based model into a participatory, capacity-building framework that empowers companies to disclose environmental information more meaningfully.

5. Conclusions

This study provides empirical evidence that climate risk dimensions—specifically physical, reputational, and regulatory risks—are significantly associated with the level of corporate water disclosure in Indonesia's water-intensive industries. The analysis of secondary data from the Refinitiv database, the Water Risk Atlas, and company annual reports reveals that physical and reputational risks encourage firms to disclose more comprehensive water-related information. In contrast, regulatory risks negatively affect disclosure, diverging from prior theoretical expectations. This study contributes to the literature by integrating climate-risk dimensions into corporate water disclosure research in a developing country context, providing empirical evidence that has been largely missing from prior studies dominated by developed-market settings.

Overall, the findings confirm that physical and reputational risks encourage greater water disclosure. In contrast, regulatory risk shows a significant negative relationship, indicating that rigid or complex regulations may discourage firms from reporting more transparently. These

results highlight the need for regulatory reforms that emphasize supportive and capacity-building approaches rather than compliance pressure alone.

To strengthen environmental accountability, policymakers should consider transitioning from a sanction-oriented model to an incentive-based regulatory approach, integrating water disclosure requirements more effectively into mandatory sustainability and annual reports on the Indonesia Stock Exchange.

This research acknowledges several limitations. First, reliance on secondary data sources may introduce reporting inconsistencies. Second, dummy variables representing physical and reputational risks may not fully capture their intensity. Third, the short observation period (2021–2023) limits the ability to detect long-term effects. Future research should develop more nuanced risk indices, incorporate governance moderators, and employ longitudinal designs to better understand corporate adaptation to climate-related risks over time. Future studies may also extend the analysis through cross-country comparisons, particularly across emerging Asian economies, to examine whether institutional and regulatory differences shape corporate water disclosure responses to climate-related risks.

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Data Availability

No new data were created or analyzed in this work. Data sharing is not applicable to this article.

Conflicts of Interest

The authors have no conflict of interest to declare.

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