

# Regulating Resilient Supply Chains: An Adaptive Governance Approach to Corporate Responsibility in Sustainable Coastal Economies

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## ABSTRACT

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This paper examines the legal framework governing climate-resilient supply chains in coastal economies through an adaptive governance lens, with particular reference to Indonesia. As climate change intensifies systemic risks in coastal social-ecological systems, supply chains in fisheries and aquaculture sectors face growing regulatory and institutional challenges. This study addresses two central questions: first, how national and local legal frameworks integrate adaptive governance principles in regulating coastal supply chains; and second, how corporate governance norms respond to climate risks and whether existing legal instruments adequately promote sustainability and resilience. Employing a normative juridical methodology, this research relies on doctrinal analysis of primary and secondary legal materials, including environmental law, maritime and fisheries regulation, regional governance instruments, and corporate law frameworks. Through systematic statutory interpretation and regulatory coherence assessment, the study evaluates the extent to which Indonesian law embodies principles of flexibility, multi-level coordination, risk internalization, and sustainability integration. The findings indicate that while sustainability is normatively embedded in various legal instruments, the regulatory architecture remains fragmented and predominantly compliance-oriented. Corporate governance provisions, although increasingly incorporating environmental responsibility, do not yet fully operationalize climate risk integration within supply chain management. The paper argues that a transition toward adaptive governance requires harmonizing environmental regulation with climate-responsive corporate governance to ensure resilient and sustainable coastal economies.

*Keywords:* Adaptive Governance, Climate Law, Corporate Governance, Coastal Economy, Supply Chain Regulation

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## 1. INTRODUCTION

Climate change has evolved from an environmental concern into a systemic risk that profoundly affects legal systems, economic structures, and governance arrangements [1]. Coastal regions are among the most vulnerable areas to climate-induced disruptions, including sea-level rise, coastal erosion, salinity intrusion, and the increasing frequency of extreme weather events [2]. These disturbances do not merely threaten ecosystems; they destabilize production networks, infrastructure, and community livelihoods embedded within coastal economies. In this context, supply chains operating in fisheries and aquaculture sectors are particularly exposed, as they depend on fragile social-ecological systems. Consequently, resilience in coastal supply chains cannot be understood solely as a matter of logistical efficiency or risk management, but rather as a question of regulatory design and institutional adaptability [3].

Indonesia, as the world's largest archipelagic state, possesses an extensive coastline and a significant proportion of its population residing in coastal areas [4]. The fisheries and aquaculture sectors contribute substantially to national and regional economic development, employment generation, and food security [5]. Coastal production systems in Indonesia function through interconnected supply networks involving small-scale producers, intermediaries, processing industries, distributors, and export-oriented enterprises [6]. However, these systems are structurally vulnerable to climate variability. Disruptions in production cycles, declining yields due to ecological degradation, and infrastructure damage from extreme weather events collectively expose the

fragility of coastal supply chains. Such vulnerabilities raise critical questions about whether existing legal frameworks are capable of anticipating and governing systemic climate risks [7].

Recent climate assessments further underscore the structural urgency of regulatory reform. According to Berkeley Earth's latest analysis, the global mean temperature in 2025 is estimated to be approximately  $1.44 \pm 0.09$  °C above the 1850–1900 average, a period widely regarded as the pre-industrial baseline for international climate targets [8]. Although slightly lower than the record temperatures observed in 2024 and marginally cooler than 2023, 2025 nonetheless ranks as the third warmest year since systematic thermometer-based measurements began in the mid-nineteenth century [8]. Importantly, the past eleven years collectively represent the warmest period ever recorded in modern observational history [8]. While direct instrumental data are limited to the post-1850 period, paleoclimatic evidence suggests that current global temperatures may be the highest in several millennia, and potentially unprecedented since the last interglacial period approximately 120,000 years ago [8].

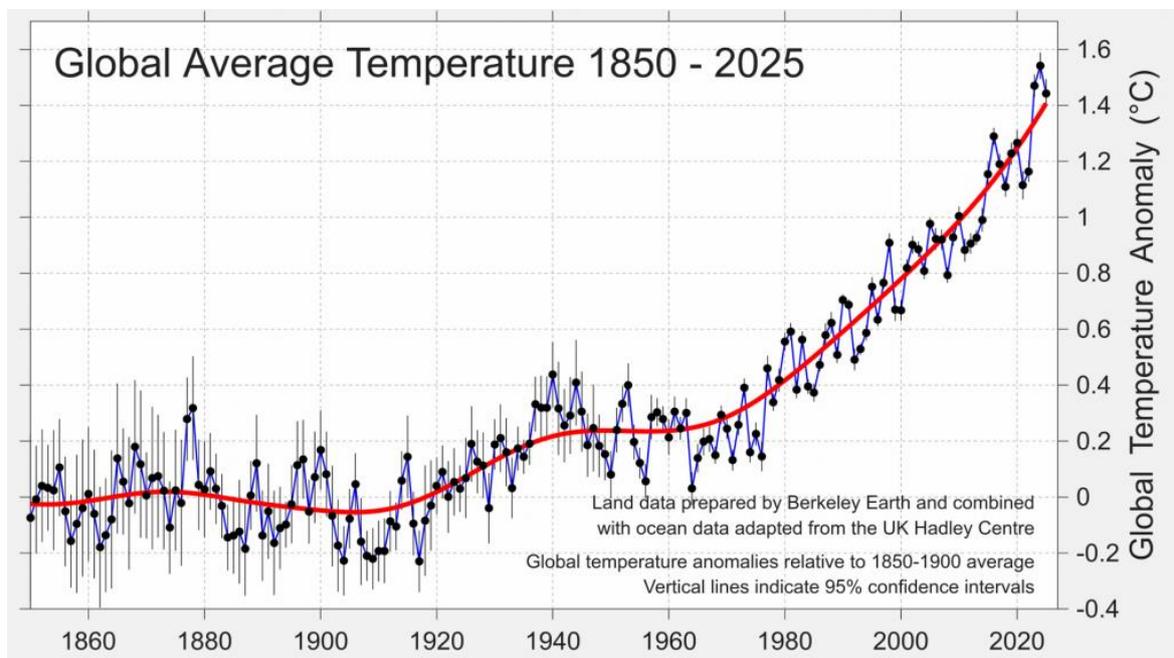


Figure 1. Global Average Temperature (1850-2050)

Source: Robert Rohde (2025)

These figures are not merely climatological observations; they reflect an accelerating trajectory of systemic environmental transformation with direct implications for coastal production systems. Sustained temperature increases intensify sea-level rise, alter marine ecosystems, and amplify extreme weather variability, factors that directly disrupt fisheries, aquaculture, and related supply chain networks. In this context, climate change represents a legally relevant structural risk rather than a distant environmental concern. The persistence of record-breaking temperatures over the past decade reinforces the need for regulatory frameworks that move beyond static sustainability commitments toward adaptive governance capable of internalizing climate risk within both environmental regulation and corporate governance structures.

The role of corporations further complicates this regulatory landscape. Coastal supply chains involve a range of corporate actors, from processing companies to exporters and logistics

providers [9]. Through contractual arrangements, sourcing practices, and investment decisions, corporations influence risk distribution within supply networks. Contemporary corporate governance discourse increasingly recognizes environmental, social, and governance (ESG) considerations and climate risk disclosure [10]. However, in many jurisdictions, including Indonesia, corporate environmental responsibility remains largely compliance-oriented. The extent to which legal norms incentivize the internalization of climate risks within corporate governance structures remains contested [11]. Without integrating corporate accountability into climate governance, efforts to enhance supply chain resilience risk remaining incomplete and uneven.

Recent scholarship increasingly acknowledges the importance of adaptive governance in strengthening supply chain resilience and sustainability, particularly in contexts characterized by environmental and market volatility. Studies in management and industrial policy demonstrate that adaptive governance frameworks enable firms to align technological innovation with regulatory mechanisms, thereby facilitating sustainable transformation in capital-intensive sectors (Krimi et al., 2025) [12]. Empirical research on global value chains further shows that adaptive governance enhances supplier resilience during systemic shocks, such as the COVID-19 pandemic, by encouraging resource reconfiguration and strategic flexibility (Islam & Chadee, 2023) [13]. In maritime and coastal settings, governance models that distribute carbon responsibility among producers and consumers have been shown to improve both efficiency and equity in emissions management (Zheng et al., 2025) [14]. Likewise, research on seafood supply chains highlights the importance of diversity, institutional support, connectivity, and trust-based collaboration in sustaining socio-ecological resilience (Subramaniam et al., 2023) [15], while cross-organizational governance mechanisms, both contractual and relational, are found to positively influence resilience performance within complex institutional environments (Wu et al., 2023) [16].

While these contributions significantly advance understanding of adaptive governance within business and sustainability studies, they remain predominantly empirical and managerial in orientation. The existing literature largely conceptualizes adaptive governance as a strategic or organizational capability, rather than as a legally structured and normatively grounded regulatory framework. Consequently, limited attention has been given to how national climate law, environmental regulation, and corporate governance doctrines interact to institutionalize adaptive principles within coastal economic systems. In particular, there is a paucity of doctrinal analysis examining whether and how legal norms mandate risk internalization, multi-level coordination, and long-term resilience planning within climate-vulnerable coastal supply chains.

Against this backdrop, this article addresses two central questions: first, how national and regional legal frameworks integrate principles of adaptive governance in regulating climate-vulnerable coastal supply chains; and second, how corporate governance practices respond to climate risks and the extent to which existing legal norms promote sustainability and resilience within supply chain structures. The objective of this study is to evaluate the coherence of Indonesia's regulatory architecture and to propose normative pathways for embedding adaptive governance within environmental and corporate law regimes. The study contributes theoretically by integrating climate law and corporate governance within a unified adaptive governance framework; normatively by identifying regulatory gaps and proposing reform directions; and practically by offering a structured analytical model for policymakers and corporate actors seeking to strengthen resilient and sustainable coastal economies.

## 2. LITERATURE REVIEW

### 2.1 *Adaptive Governance in Climate and Supply Chain Regulation*

The concept of adaptive governance emerged from resilience theory and socio-ecological systems scholarship, particularly through the works of C.S. Holling on ecological resilience [17], Elinor Ostrom on polycentric governance [18], and Folke and colleagues on institutional adaptation in complex environmental systems [19]. Unlike traditional command-and-control regulation, which assumes stability and predictability, adaptive governance recognizes uncertainty, non-linearity, and systemic risk as defining characteristics of environmental and economic systems [20]. It therefore emphasizes institutional flexibility, iterative learning, stakeholder participation, and multi-level coordination. In the context of climate change, where scientific uncertainty coexists with escalating risk, adaptive governance offers a regulatory paradigm capable of responding to evolving environmental disruptions without sacrificing legal legitimacy.

Within climate law, adaptive governance reflects a gradual normative shift from mitigation-centered frameworks toward resilience-oriented regulatory design [21]. Early climate regimes primarily focused on emission reduction targets and compliance mechanisms [22]. However, the intensification of climate impacts, particularly in vulnerable coastal regions, has required legal systems to integrate adaptation planning, disaster risk reduction, and long-term resilience strategies. Adaptive governance in climate law thus involves embedding mechanisms for regulatory revision, cross-sector coordination, and risk internalization within statutory and administrative structures. The emphasis moves beyond static compliance toward dynamic responsiveness, enabling legal frameworks to accommodate new scientific knowledge and emerging socio-economic vulnerabilities.

The relevance of adaptive governance extends to supply chain regulation, especially where supply networks depend on climate-sensitive natural resources. Coastal economies often rely on fisheries, aquaculture, maritime transport, and marine-based industries, all of which are exposed to sea-level rise, ecosystem degradation, and extreme weather variability [23]. Supply chains in such contexts function not merely as economic arrangements but as socio-ecological systems embedded within environmental constraints. While management scholarship has extensively explored operational flexibility and diversification strategies to enhance resilience, less attention has been given to how legal systems structure the institutional conditions for adaptive supply chain governance. The regulatory environment determines the allocation of rights, responsibilities, and risk-bearing obligations across public authorities and private actors.

Despite growing interdisciplinary interest, existing literature remains predominantly empirical and managerial, conceptualizing adaptive governance as an organizational capability rather than a legally institutionalized framework [24]. There is limited doctrinal analysis assessing whether statutory provisions, regulatory instruments, and administrative mechanisms genuinely embody adaptive principles such as multi-level coordination, iterative review, and systemic risk internalization [25]. Consequently, a normative inquiry is necessary to evaluate the extent to which climate

and environmental law create enabling, or constraining, conditions for adaptive supply chain resilience in coastal economies. This doctrinal perspective forms the theoretical foundation for assessing regulatory coherence and institutional responsiveness within climate-vulnerable jurisdictions.

## 2.2 *Corporate Governance and Climate Responsibility in Coastal Economies*

Corporate governance has undergone significant transformation over the past decades, evolving from a shareholder-centric model toward a broader stakeholder-oriented framework that incorporates environmental and social considerations [26]. Traditional corporate governance focused primarily on profit maximization and fiduciary duties to shareholders. However, the rise of sustainability discourse, environmental, social, and governance (ESG) standards, and climate-related financial risk disclosure has expanded the scope of corporate accountability. Climate risk is increasingly framed not merely as an external environmental concern but as a material financial and governance issue that falls within the oversight responsibilities of corporate boards and executive management [27]. This shift redefines corporate governance as a mechanism for managing long-term systemic risk.

In supply chain contexts, corporate governance extends beyond internal corporate structures to encompass relationships with suppliers, contractors, and downstream actors [28]. Contractual governance mechanisms, compliance systems, and sustainability reporting frameworks are increasingly used to monitor environmental performance across supply networks. At the same time, relational governance, based on trust, collaboration, and shared standards, plays a significant role in maintaining stability within complex global and regional value chains. For climate-vulnerable coastal economies, corporate governance decisions regarding sourcing, investment, infrastructure resilience, and environmental compliance directly influence the adaptive capacity of local production systems [29]. The governance of supply chains therefore becomes a site where private decision-making intersects with public regulatory objectives.

Nevertheless, much of the corporate governance literature addresses sustainability from a disclosure or voluntary compliance perspective rather than from a structural regulatory standpoint [30]. While ESG integration and climate risk reporting have gained prominence, questions remain regarding the extent to which corporate governance is normatively compelled, rather than merely encouraged, to internalize climate risks within strategic decision-making [31]. In many jurisdictions, climate-related obligations remain fragmented across environmental, corporate, and sectoral regulations [32]. This fragmentation raises concerns about regulatory coherence, particularly in coastal economies where environmental degradation and economic vulnerability are deeply intertwined.

A doctrinal examination of the interaction between climate law and corporate governance is therefore necessary to assess whether legal frameworks effectively mandate resilience-oriented corporate conduct [33]. In coastal settings, where marine resource governance, regional autonomy, and national climate policy intersect, the legal system must provide clarity regarding corporate duties, accountability mechanisms, and risk allocation. The integration of adaptive governance principles into corporate

law and environmental regulation determines whether corporations function merely as regulated entities or as active participants in climate resilience strategies. By situating corporate governance within an adaptive regulatory paradigm, this study evaluates the extent to which law facilitates the internalization of climate risk and supports sustainable supply chain resilience in coastal economies.

### 3. METHODS

This study employs a normative legal research method grounded in doctrinal analysis to examine the extent to which existing regulatory frameworks embody principles of adaptive governance in regulating climate-resilient supply chains within coastal economies. Normative legal research focuses on the systematic examination of legal norms, statutory provisions, regulatory instruments, and doctrinal principles to assess their coherence, consistency, and conceptual adequacy. Rather than generating empirical data, this approach evaluates law as a normative system, analyzing how climate legislation, environmental regulations, and corporate governance rules structure rights, obligations, and accountability mechanisms. The research relies on primary legal materials, including statutory texts, governmental regulations, and relevant policy instruments, supplemented by secondary sources such as scholarly commentary and theoretical literature on adaptive governance, climate law, and corporate governance. Through conceptual and statutory interpretation, the study identifies whether the regulatory framework institutionalizes flexibility, multi-level coordination, and risk internalization consistent with adaptive governance principles.

Analytically, the research adopts a qualitative and conceptual approach by operationalizing adaptive governance as an evaluative framework. Core principles, such as institutional flexibility, polycentric coordination, iterative learning, and systemic risk internalization, are translated into doctrinal indicators used to assess regulatory design and corporate governance obligations. The study further applies a vertical and horizontal coherence analysis: vertically, by examining the alignment between national climate policies and subnational coastal governance arrangements; and horizontally, by evaluating the interaction between environmental law and corporate governance regimes in shaping supply chain resilience. This methodological design enables a structured assessment of whether legal norms merely articulate sustainability objectives in abstract terms or substantively embed adaptive mechanisms capable of responding to climate-induced disruptions in coastal economic systems.

### 4. RESULTS AND DISCUSSION

#### 4.1 Integration of Adaptive Governance Principles within National and Regional Legal Frameworks

The integration of adaptive governance principles within Indonesia's national and regional legal frameworks must be assessed against the country's evolving climate and environmental regulatory architecture. At the national level, climate adaptation and sustainability objectives are embedded in several key statutes and policy instruments, including Law No. 32 of 2009 on Environmental Protection and Management as amended by Law No. 6 of 2023 on Job Creation, Law No. 27 of 2007 on the Management of Coastal Areas and Small Islands, as amended by Law No. 1 of 2014, and Law No. 32 of 2014 on Marine Affairs. Climate governance is further strengthened through Presidential Regulation No. 98 of 2021 on the Implementation of Carbon Economic Value for Achieving Nationally Determined Contribution Targets, and Presidential Regulation No. 111 of 2022 on the Implementation of Climate Change Adaptation and Mitigation. Collectively, these instruments demonstrate a formal normative shift toward sustainability, adaptation, and low-carbon development. However, the question remains whether these regulatory provisions substantively institutionalize adaptive governance principles rather than merely articulating policy commitments.

From the perspective of institutional flexibility, several statutory frameworks provide mechanisms for periodic review and policy recalibration. For instance, spatial planning instruments under Law No. 26 of 2007 on Spatial Planning require periodic evaluation, while environmental approvals and environmental impact assessments (AMDAL) under Law No. 32 of 2009 incorporate monitoring and compliance mechanisms [34]. Additionally, national climate planning documents such as Indonesia's Nationally Determined Contribution (NDC) and Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR) are subject to iterative revision in response to international commitments and scientific developments [35]. Nevertheless, doctrinal analysis reveals that these review mechanisms are often procedural and administrative in nature. They do not consistently mandate science-based reassessment of climate risks within sector-specific supply chains, particularly in fisheries, aquaculture, salt production, and maritime logistics. As a result, adaptive capacity exists formally but is not always operationalized through dynamic regulatory obligations targeting systemic coastal supply chain vulnerabilities.

At the regional level, Indonesia's decentralization framework under Law No. 23 of 2014 on Regional Government allocates significant authority to provincial governments in managing marine areas up to 12 nautical miles, including coastal zoning and marine resource governance [36]. Regional governments are required to formulate Regional Spatial Plans (RTRW) and Coastal and Small Islands Zoning Plans (RZWP3K), which function as key regulatory instruments for integrating climate adaptation into local economic planning [37]. In principle, this polycentric governance structure aligns with adaptive governance theory by enabling context-sensitive responses to environmental risk. However, coordination challenges frequently arise between national climate policies and regional implementation. Overlapping sectoral mandates, administrative capacity disparities, and inconsistencies between national strategic projects and local environmental priorities can undermine vertical coherence [38]. Consequently, while decentralization creates structural opportunities for adaptive governance, its effectiveness depends heavily on intergovernmental harmonization and institutional capacity.

Moreover, although environmental and coastal regulations contribute indirectly to supply chain sustainability, they rarely conceptualize supply chains as integrated socio-economic systems exposed to cascading climate risk. Legal obligations under Law No. 32 of 2009 emphasize pollution control, environmental permits, and liability mechanisms, while Law No. 27 of 2007 focuses on coastal resource allocation and conservation [39]. These frameworks protect environmental assets but do not explicitly mandate climate resilience planning across interconnected production and distribution networks. The absence of explicit statutory linkage between climate adaptation policies and supply chain governance reveals a structural gap in the regulatory architecture. Without doctrinal clarification that supply chain resilience constitutes a regulatory objective, adaptive governance remains only partially embedded within Indonesia's environmental and coastal law regime.

Indonesia's legal framework demonstrates significant normative progress in incorporating sustainability and climate adaptation principles. Key statutes and presidential regulations provide procedural flexibility, decentralization mechanisms, and environmental safeguards consistent with elements of adaptive governance. However, the integration remains fragmented and indirect. Institutional flexibility is present but not systematically tied to science-based risk recalibration in supply chain sectors; polycentric governance structures exist but face coordination constraints; and climate risk is not yet fully internalized within sectoral regulatory obligations affecting coastal economic systems. Strengthening adaptive governance therefore requires clearer statutory mandates linking climate adaptation, intergovernmental coordination, and supply chain resilience within both national and regional legal frameworks.

Table 1. Integration of Adaptive Governance Principles within National and Regional Legal Frameworks in Indonesia

Adaptive Governance Principle	Relevant National Regulations	Relevant Regional Frameworks	Degree of Integration	Identified Gaps
Institutional Flexibility	Law No. 32/2009 (Environmental Protection); Law No. 26/2007 (Spatial Planning); Presidential Regulation No. 111/2022 (Climate Adaptation & Mitigation)	Regional Spatial Plans (RTRW); Coastal Zoning Plans (RZWP3K)	Partial (procedural review mechanisms exist)	Limited mandatory science-based recalibration for sector-specific climate risk
Iterative Policy Learning	Environmental monitoring & AMDAL under Law No. 32/2009; NDC & LTS-LCCR updates	Regional development planning (RPJMD)	Moderate	No explicit legal requirement linking updated climate science to supply chain regulation
Polycentric Governance	Law No. 23/2014 (Regional Government); Law No. 32/2014 (Marine Affairs)	Provincial authority over marine areas (0–12 nautical miles)	Structurally present	Coordination inconsistencies and overlapping mandates
Multi-level Coordination	Presidential Regulation No. 98/2021 (Carbon Economic Value); National Climate Policies	Implementation through provincial and local regulations	Moderate	Fragmentation between national climate targets and regional execution
Risk Internalization in Coastal Supply Chains	Law No. 27/2007 & Law No. 1/2014 (Coastal Management); Environmental licensing regime	Local marine resource governance and licensing	Indirect	No explicit statutory obligation integrating climate resilience into supply chain governance

#### 4.2 Corporate Governance Responses to Climate Risk and Legal Promotion of Supply Chain Resilience

In Indonesia, corporate governance has gradually evolved to incorporate sustainability-oriented principles, particularly through mandatory Corporate Social Responsibility (CSR) obligations under Law No. 40 of 2007 on Limited Liability Companies, as amended by Law No. 6 of 2023, and through sustainable finance and ESG disclosure requirements under regulations issued by the Financial Services Authority (OJK), including OJK Regulation No. 51/POJK.03/2017 on the Implementation of Sustainable Finance [40]. These regulatory developments signal a normative shift in which environmental stewardship and risk management are increasingly recognized as components of responsible corporate conduct. Environmental compliance obligations, sustainability reporting, and enterprise risk management frameworks indicate that corporations, especially those operating in coastal and marine-dependent sectors, are progressively exposed to climate-related regulatory and reputational accountability.

Notwithstanding these developments, the doctrinal integration of climate risk within corporate governance remains structurally constrained. Indonesian corporate law continues to conceptualize directors' duties primarily in terms of fiduciary responsibility, prudential management, and the protection of corporate interests. Although sustainability considerations may be interpreted as part of long-term corporate value protection, climate risk is not uniformly codified as an explicit fiduciary obligation. Environmental liabilities are largely governed under environmental statutes, while corporate law addresses governance structure and managerial accountability [41]. This bifurcation generates a normative disconnect: corporations may satisfy environmental licensing and compliance requirements without being legally compelled to embed

long-term climate resilience into core governance strategy, including supply chain planning and investment decisions.

Within supply chain governance, corporations increasingly deploy contractual mechanisms, supplier codes of conduct, sustainability standards, and environmental due diligence procedures to manage climate-related exposure [42]. These instruments function as private governance tools that extend environmental responsibility beyond corporate boundaries to upstream and downstream actors. However, many such mechanisms operate within voluntary or semi-voluntary regulatory spaces. While sustainable finance regulations encourage transparency and ESG integration, there remains no comprehensive statutory mandate explicitly requiring climate risk disclosure across supply chain networks [43]. In climate-vulnerable coastal economies, where fisheries, aquaculture, and marine-based industries depend heavily on ecosystem stability, the absence of binding climate risk integration in supply chain governance may heighten vulnerability to cascading disruptions triggered by extreme weather events, sea-level rise, or ecological degradation.

Accordingly, existing legal norms in Indonesia promote sustainability as a general regulatory objective but do not yet fully institutionalize resilience within corporate governance doctrine. The current regulatory architecture encourages responsible environmental conduct and disclosure; yet it stops short of mandating the systematic internalization of climate risk as a central fiduciary and strategic obligation. Embedding adaptive governance within corporate law would require clearer statutory articulation that climate risk constitutes a material governance concern, strengthened mandatory disclosure frameworks linked to supply chain exposure, and enhanced integration between environmental regulatory compliance and corporate oversight responsibilities. Such reforms would transform climate resilience from a peripheral compliance matter into a structurally embedded dimension of corporate governance in coastal economic systems.

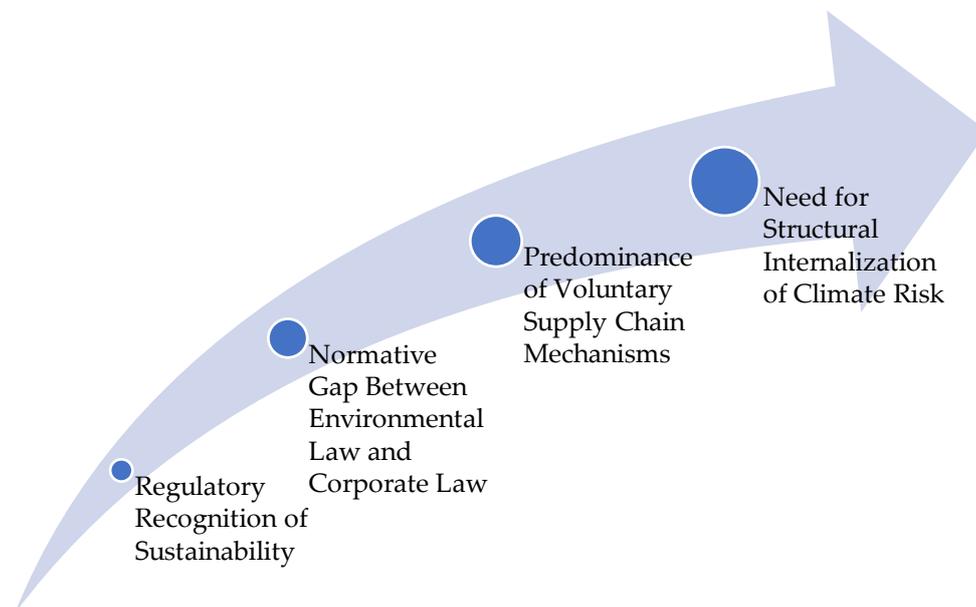


Figure 2. Corporate Governance and Climate Risk Integration in Coastal Supply Chains

#### 4.3 Normative Pathways for Embedding Adaptive Governance in Indonesia's Regulatory Architecture

The preceding analysis of national environmental regulation and corporate governance frameworks demonstrates a structural disjunction between climate adaptation policy and supply chain governance. Although sustainability and resilience are formally recognized within both environmental statutes and corporate regulatory regimes, their interaction remains fragmented and sectorally compartmentalized. Environmental law primarily focuses on resource protection, licensing, and compliance, while corporate governance law emphasizes fiduciary responsibility,

financial prudence, and organizational oversight [44]. This segmentation weakens the systemic capacity of the legal order to respond to climate-induced disruptions that affect interconnected coastal production and distribution networks. Adaptive governance, by contrast, presupposes cross-sectoral coherence, iterative learning, and institutional alignment across regulatory domains.

Addressing this structural gap requires a normative reconstruction of Indonesia's regulatory architecture. First, environmental and climate legislation should explicitly articulate supply chain resilience as a regulatory objective, particularly in sectors highly exposed to climate variability such as fisheries, aquaculture, marine transportation, and coastal infrastructure. Climate adaptation mandates should incorporate legally binding requirements for risk mapping, periodic vulnerability reassessment, and integration of scientific data into sectoral planning. Second, corporate governance statutes and implementing regulations should clarify that climate risk constitutes a material governance concern. This would entail embedding climate-related oversight within directors' fiduciary duties, strengthening board-level accountability for sustainability strategy, and mandating disclosure of climate exposure across supply chain structures.

Third, strengthening vertical and horizontal coordination mechanisms is essential for operationalizing adaptive governance. Vertically, alignment between national climate commitments and regional coastal regulatory instruments must be reinforced through clearer allocation of competencies, harmonized planning frameworks, and integrated monitoring systems. Horizontally, environmental compliance regimes should be more closely integrated with corporate governance obligations, ensuring that environmental licensing, risk management, and sustainability reporting function as mutually reinforcing components of a unified regulatory system. Such integration would enhance institutional flexibility while preserving legal certainty, allowing regulatory responses to evolve in accordance with emerging climate science without generating normative instability.

From a theoretical perspective, embedding adaptive governance within Indonesia's regulatory architecture advances a systemic conception of legal resilience. Rather than treating environmental protection and corporate accountability as distinct spheres, this approach conceptualizes them as interdependent elements of a dynamic governance ecosystem. Normatively, it identifies regulatory fragmentation as a central obstacle to climate-resilient supply chains and proposes concrete pathways for doctrinal reform. Practically, it offers policymakers and corporate actors a structured analytical model for strengthening sustainable coastal economies, ensuring that climate risk management becomes an integrated, enforceable, and forward-looking component of both public regulation and private governance.

Table 3. *Normative Pathways for Embedding Adaptive Governance in Indonesia's Regulatory Architecture*

<b>Reform Dimension</b>	<b>Identified Structural Gap</b>	<b>Proposed Normative Pathway</b>	<b>Expected Governance Outcome</b>
Environmental and Climate Law	Adaptation policies not explicitly linked to supply chain resilience	Incorporate supply chain resilience as a statutory objective; mandate periodic climate risk reassessment and science-based policy updating	Stronger integration of climate adaptation within coastal economic regulation
Corporate Governance Framework	Climate risk not clearly codified as a fiduciary obligation	Clarify climate risk as a material governance concern; strengthen board oversight and mandatory disclosure requirements	Internalization of climate risk within corporate strategy and supply chain management
Vertical Governance Coordination	Fragmentation between national and regional regulatory implementation	Harmonize planning instruments; clarify allocation of authority; integrate monitoring systems	Improved coherence and consistency across coastal jurisdictions

Horizontal Regulatory Integration	Separation between environmental compliance and corporate accountability regimes	Align environmental licensing, risk management, and ESG reporting frameworks	Unified regulatory ecosystem supporting adaptive and resilient supply chains
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## 5 CONCLUSION

This study has examined the extent to which Indonesia's national and regional legal frameworks integrate principles of adaptive governance in regulating climate-vulnerable coastal supply chains, and how corporate governance regimes respond to climate risk within supply chain structures. The analysis demonstrates that Indonesia's regulatory architecture has made significant normative progress in embedding sustainability and climate adaptation objectives within environmental, marine, and spatial planning laws, as well as within corporate governance and sustainable finance frameworks. Nevertheless, the integration of adaptive governance remains partial and structurally fragmented. Institutional flexibility exists but is largely procedural; polycentric governance structures are formally established but constrained by coordination challenges; and climate risk is not yet consistently internalized as a material fiduciary and strategic obligation within corporate governance doctrine. As a result, coastal supply chain resilience is supported indirectly through sectoral regulation rather than systematically embedded within a coherent adaptive legal framework.

The findings underscore the need for a normative reconstruction that aligns climate law and corporate governance within a unified adaptive governance paradigm. Embedding supply chain resilience as an explicit regulatory objective in environmental and coastal legislation, clarifying climate risk as a core governance responsibility of corporate directors, and strengthening vertical and horizontal coordination mechanisms are essential steps toward enhancing systemic resilience. Theoretically, this study contributes by integrating climate law and corporate governance within a single adaptive governance framework, advancing a more holistic understanding of regulatory resilience. Normatively and practically, it provides structured pathways for reform that can guide policymakers and corporate actors in strengthening sustainable and climate-resilient coastal economies amid escalating environmental uncertainty.

## REFERENCES

- [1] B. Choudhury, "Climate change as systemic risk," *Berkeley Bus. LJ*, vol. 18, p. 52, 2021.
- [2] R. Guild, X. Wang, and P. A. Quijón, "Climate change impacts on coastal ecosystems," *Environmental Research: Climate*, vol. 3, no. 4, p. 042006, 2024.
- [3] J. Verschuur, R. Pant, E. Koks, and J. Hall, "A systemic risk framework to improve the resilience of port and supply-chain networks to natural hazards," *Maritime Economics & Logistics*, vol. 24, no. 3, pp. 489–506, 2022.
- [4] L. Sui, J. Wang, X. Yang, and Z. Wang, "Spatial-temporal characteristics of coastline changes in Indonesia from 1990 to 2018," *Sustainability*, vol. 12, no. 8, p. 3242, 2020.
- [5] S. Gul, U. Shafiq, S. A. Mir, G. Iqbal, and H. Q. Lone, "Enhancing global food security through sustainable fisheries and aquaculture: A comprehensive review," *Asian Journal of Agricultural Extension, Economics & Sociology*, vol. 42, no. 10, pp. 60–70, 2024.
- [6] Y. N. Rahmat and J. Neilson, "Livelihood upgrading in global production networks: Household commodity producers in an Indonesian Coastal Community," *Environment and Planning A: Economy and Space*, p. 0308518X251414417, 2026.
- [7] A. Naylor, J. Ford, T. Pearce, and J. Van Alstine, "Conceptualizing climate vulnerability in complex adaptive systems," *One Earth*, vol. 2, no. 5, pp. 444–454, 2020.
- [8] R. Rohde, "Global Temperature Report for 2025," Berkeley Earth. Accessed: Feb. 24, 2026. [Online]. Available: <https://berkeleyearth.org/global-temperature-report-for-2025/>
- [9] T. Notteboom, L. Van Der Lugt, N. Van Saase, S. Sel, and K. Neyens, "The role of seaports in green supply chain management: Initiatives, attitudes, and perspectives in Rotterdam, Antwerp, North Sea Port, and Zeebrugge," *Sustainability*, vol. 12, no. 4, p. 1688, 2020.
- [10] C. De Silva Lokuwaduge and K. De Silva, "Emerging corporate disclosure of environmental social and governance (ESG) risks: An Australian study," *Australasian Accounting, Business and Finance Journal*, vol. 14, no. 2, pp. 35–50, 2020.
- [11] C. M. Bruner, "Corporate governance reform and the sustainability imperative," *Yale LJ*, vol. 131, p. 1217, 2021.

- [12] I. Krimi, T. Saikouk, I. Badraoui, and Z. Bahou, "Enabling sustainable and resilient supply chain expansion through technological advancements: Corporate policy insights from the Gulf petrochemical industry," *Journal of Environmental Management*, vol. 390, p. 126068, Aug. 2025, doi: 10.1016/j.jenvman.2025.126068.
- [13] M. T. Islam and D. Chadee, "Adaptive governance and resilience of global value chains: A framework for sustaining the performance of developing-country suppliers during exogenous shocks," *International Business Review*, vol. 33, no. 2, p. 102248, Apr. 2024, doi: 10.1016/j.ibusrev.2023.102248.
- [14] S. Zheng, N. A. K. Nandasena, C. Chen, and F. Wu, "Sustainable Risk Governance in Maritime Transport: Embodied Carbon Emissions and Responsibility Distribution Across BRICS Coastal Economies," *Sustainability*, vol. 17, no. 8, p. 3573, Apr. 2025, doi: 10.3390/su17083573.
- [15] R. C. Subramaniam *et al.*, "The socio-ecological resilience and sustainability implications of seafood supply chain disruption," *Rev Fish Biol Fisheries*, vol. 33, no. 4, pp. 1129–1154, Dec. 2023, doi: 10.1007/s11160-023-09788-1.
- [16] Q. Wu, J. Zhu, and Y. Cheng, "The effect of cross-organizational governance on supply chain resilience: A mediating and moderating model," *Journal of Purchasing and Supply Management*, vol. 29, no. 1, p. 100817, Jan. 2023, doi: 10.1016/j.pursup.2023.100817.
- [17] C. S. Holling, "Engineering resilience versus ecological resilience," *Engineering within ecological constraints*, vol. 31, no. 1996, p. 32, 1996.
- [18] H. Nagendra and E. Ostrom, "Polycentric governance of multifunctional forested landscapes," *International Journal of the Commons*, vol. 6, no. 2, 2012.
- [19] C. Folke, L. Pritchard Jr, F. Berkes, J. Colding, and U. Svedin, "The problem of fit between ecosystems and institutions: ten years later," *Ecology and society*, vol. 12, no. 1, 2007.
- [20] P.-J. Schweizer, "Systemic risks—concepts and challenges for risk governance," *Journal of Risk Research*, vol. 24, no. 1, pp. 78–93, 2021.
- [21] C. Mendoza and D. Reyes, "Legitimacy as Infrastructure: Justification Work, Delegated Expertise, and the Social Organization of Renewable Energy Deployment," *Review of Multidisciplinary Science, Technology and Applied Research*, vol. 15, no. 12, pp. 1–17, 2025.
- [22] W. Hare, C. Stockwell, C. Flachsland, and S. Oberthür, "The architecture of the global climate regime: a top-down perspective," *Climate policy*, vol. 10, no. 6, pp. 600–614, 2010.
- [23] P. Vinayachandran, D. C. Seng, and F. A. Schmid, "Climate change and coastal systems," in *Blue economy: an ocean science perspective*, Springer, 2022, pp. 341–377.
- [24] B. C. Chaffin, H. Gosnell, and B. A. Cosens, "A decade of adaptive governance scholarship: synthesis and future directions," *Ecology and society*, vol. 19, no. 3, 2014.
- [25] O. Lobel, "The renew deal: The fall of regulation and the rise of governance in contemporary legal thought," *Minn. L. Rev.*, vol. 89, p. 342, 2004.
- [26] D. Dutta, "Incorporating Stakeholder Theory Into Sustainable Business Practices A Route To Ethical Corporate Governance," *The Interdisciplinary Nexus: Law, Humanities, and Management*, p. 125.
- [27] R. Samans and J. Nelson, "Corporate governance and oversight," in *Sustainable Enterprise value creation: Implementing stakeholder capitalism through full ESG integration*, Springer, 2022, pp. 103–140.
- [28] J. Steinberg, "Structure and context: A multi-level approach to supply chain governance," *Annual Review of Political Science*, vol. 26, no. 1, pp. 411–429, 2023.
- [29] R. Abbasov, "Bridging Climate Adaptation Gaps: Economic Policies, Financial Mechanisms, and Stakeholder Integration for Resilient Development," *American Journal of Economics and Business Management*, vol. 8, no. 4, pp. 1529–1541, 2025.
- [30] V. Naciti, F. Cesaroni, and L. Pulejo, "Corporate governance and sustainability: A review of the existing literature," *Journal of Management and Governance*, vol. 26, no. 1, pp. 55–74, 2022.
- [31] C. M. Bruner, "Corporate governance reform and the sustainability imperative," *Yale LJ*, vol. 131, p. 1217, 2021.
- [32] T. Rayner, S. Oberthür, and L. Hermwille, "A sectoral perspective on international climate governance: Key findings and research priorities," *Earth System Governance*, vol. 8, p. 100105, 2021.
- [33] S. K. Park, "Legal strategy disrupted: Managing climate change and regulatory transformation," *American Business Law Journal*, vol. 58, no. 4, pp. 711–749, 2021.
- [34] L. Karjoko, D. W. Winarno, Z. N. Rosidah, and I. Handayani, "Spatial planning dysfunction in East Kalimantan to support green economy," *International Journal of Innovation, Creativity and Change*, vol. 11, no. 8, pp. 259–269, 2020.
- [35] A. Halimatussadiyah, M. Adriansyah, F. A. R. Afifi, M. Y. Pratama, T. Riefky, and J. Lou, *Indonesia's Decarbonization Plans Diagnostic: A Policy Paper*. Institute for Economic and Social Research, Faculty of Economics and ..., 2024.
- [36] W. Wen, K. Samudera, L. Adrianto, G. L. Johnson, M. S. Brancato, and A. White, "Towards marine spatial planning implementation in Indonesia: Progress and hindering factors," *Coastal Management*, vol. 50, no. 6, pp. 469–489, 2022.
- [37] M. Darmawan, D. Sutrisno, C. Dewi, and I. Setiyawan, "The integration of regional spatial planning (RTRW) and coastal spatial planning (RZWP3K) for the sustainable coastal area development," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2021, p. 012052.
- [38] M. A. K. Sahide *et al.*, "Navigating the hidden politics of water resource bureaucracies in Indonesia: mapping issue-elements and alliances," *Hasanuddin Law Review*, vol. 9, no. 1, pp. 57–87, 2025.
- [39] A. Hariri, L. Yustitiantingtyas, and others, "Pollution Of The Marine Environment In The Southeast Asian Region In The Perspective Of International Environmental Law," *MIMBAR YUSTITIA: Jurnal Hukum dan Hak Asasi Manusia*, vol. 9, no. 1, pp. 44–60, 2025.

- [40] H. L. Qudriyah, D. I. Burhany, S. Sumardi, and others, "An analysis of sustainable finance disclosure at Indonesian Sharia commercial banks using POJK 51/POJK. 03/2017," in *2nd International Seminar of Science and Applied Technology (ISSAT 2021)*, Atlantis Press, 2021, pp. 544–551.
- [41] S. E. Light, "The law of the corporation as environmental law," *Stan. L. Rev.*, vol. 71, p. 137, 2019.
- [42] A. Hösli and R. H. Weber, "Climate change reporting and due diligence: Frontiers of corporate climate responsibility," *European Company and Financial Law Review*, vol. 18, no. 6, pp. 948–979, 2022.
- [43] M. Gurung, S. Taneja, G. Singh, M. Kaur, and D. Kalra, "Bridging the Gap: Aligning ESG With Financial Disclosures for a Sustainable Global Trade System," in *Aligning Financial Reporting Standards With Global Trade Needs*, IGI Global Scientific Publishing, 2025, pp. 1–28.
- [44] S. E. Light, "The law of the corporation as environmental law," *Stan. L. Rev.*, vol. 71, p. 137, 2019.