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Carbon Accounting and Ethical Dilemmas in Emission Reporting: Between Compliance and Greenwashing

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Abstract

This study examines the ethical dilemma inherent in corporate carbon accounting and emissions reporting, particularly the tension between substantive regulatory compliance and strategic greenwashing. Increasing regulatory pressure and global net-zero commitments have positioned carbon disclosure as a core instrument of corporate governance; however, persistent weaknesses in measurement quality, disclosure integrity, and governance structures have generated substantial ethical challenges. This research adopts a qualitative explanatory design using systematic literature review and document analysis of 72 academic studies, regulatory reports, corporate sustainability disclosures, and enforcement cases published between 2020 and 2025. Data were analyzed through thematic content analysis and comparative institutional analysis. The results reveal that dominant corporate practices include incomplete Scope 3 reporting, selective and promotional disclosure, symbolic compliance, weak governance, and long-term net-zero targets lacking operational implementation. The findings further demonstrate a strong inverse relationship between regulatory strength and greenwashing intensity, indicating that robust climate governance and mandatory reporting significantly reduce opportunistic disclosure behavior. The discussion highlights how economic incentives, market expectations, regulatory design, and professional standards jointly shape the ethical trajectory of carbon accounting. The study concludes that carbon accounting functions either as a mechanism of genuine climate accountability under strong institutional governance or as a sophisticated instrument of greenwashing under weak regulatory environments, underscoring the need for institutional strengthening to achieve sustainable corporate climate governance.

Keywords: Carbon accounting; Emissions reporting; Ethical dilemma; Greenwashing; Climate governance; Corporate sustainability

MAIN ARTICLE

1. Introduction

Climate change has fundamentally transformed the landscape of corporate accountability, compelling firms to rethink how they measure, manage, and communicate their environmental impacts. Among the most consequential developments in this transformation is the rise of carbon accounting and greenhouse gas (GHG) emissions reporting as core instruments of corporate governance. Increasing regulatory pressure, intensifying scrutiny from capital markets, and global commitments toward net-zero targets have elevated carbon disclosure from a voluntary reputational activity to a strategic necessity for modern corporations (Mateo-Márquez et al., 2022; Khan & Devi, 2025). Yet beneath this growing institutionalization of carbon reporting lies a profound ethical dilemma: whether corporate emissions reporting reflects genuine compliance with climate responsibilities or functions primarily as a mechanism of greenwashing designed to cultivate legitimacy without substantive environmental improvement.

This dilemma emerges from persistent weaknesses in the quality and consistency of carbon accounting practices. Empirical evidence indicates that corporate carbon disclosures remain highly heterogeneous, particularly regarding value-chain emissions (Scope 3), which frequently constitute the largest share of corporate carbon footprints. Klaaßen and Stoll (2020) demonstrate that in the technology sector alone, nearly half of total emissions remain unreported in corporate disclosures, undermining the credibility of climate commitments. Such reporting inconsistencies are further amplified by selective boundary-setting, advantageous base-year choices, and the exclusion of emissions-intensive activities, thereby creating fertile ground for carbonwashing, a specific form of ESG-related greenwashing involving manipulation or distortion of emissions data (In & Schumacher, 2021; Khan & Devi, 2025).

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The ethical tension intensifies as many corporations increasingly rely on carbon offsets and distant net-zero pledges while making only marginal reductions in actual emissions. These practices often produce highly optimistic sustainability narratives that are weakly connected to operational transformation, rendering emissions reporting more symbolic than substantive (Ratti et al., 2025; Khan & Devi, 2025). Consequently, carbon accounting becomes entangled in competing institutional logics: one prioritizing accountability, transparency, and environmental integrity, and the other driven by reputational incentives, market valuation, and short-term financial performance.

Extensive international evidence reveals that the gap between discourse and performance is neither anecdotal nor isolated. In Brazil, Santos et al. (2025) find that firms with more “green” ESG narratives experience a 5.24 percent increase in emissions, indicating that sustainability reporting operates primarily as image management rather than as a reflection of environmental improvement. In the United States, Treepongkaruna et al. (2024) show that companies with high ESG ratings do not exhibit lower emissions, supporting the hypothesis of greenwashing and the prevalence of “cheap talk” in sustainability communication. Similar dynamics are observed in Australia, where high-emitting firms with deteriorating environmental performance significantly increase voluntary climate disclosures to obscure poor emissions outcomes (Wedari et al., 2021).

Nevertheless, the prevalence of greenwashing is not universal. Cross-country studies indicate that stricter climate regulation significantly reduces greenwashing tendencies in voluntary carbon disclosure (Mateo-Márquez et al., 2022). Evidence from Indonesia further demonstrates that carbon disclosure quality between 2020 and 2022 is aligned with actual emissions intensity, suggesting that effective institutional environments can foster substantive rather than symbolic climate accountability (Wahyuningrum et al., 2024). These contrasting findings reveal that ethical outcomes in carbon accounting are contingent upon regulatory rigor, governance structures, and enforcement mechanisms.

From an economic perspective, the ethical dilemma is intensified by the asymmetric distribution of costs and benefits. High-quality carbon disclosure is positively associated with firm value, and even greenwashing can temporarily enhance valuation by lowering capital costs through inflated investor expectations (Cao et al., 2022). However, once greenwashing is revealed, firms face significant long-term consequences, including negative abnormal stock returns, reputational erosion, regulatory sanctions, and litigation risks (Xu et al., 2023; Khadim, 2024; Wu, 2025). The case of Lululemon illustrates this pattern: sustainability claims generated short-term profitability gains, yet emissions doubled, leading to supply-chain cost escalation and substantial legal exposure (Wu, 2025).

Regulation and the accounting profession play a pivotal role in mitigating this ethical conflict. Mandatory emissions reporting programs in the United States have significantly reduced greenwashing by improving real ESG performance and constraining exaggerated sustainability claims, particularly among large firms (Luu et al., 2024). Similarly, countries with more extensive climate regulations exhibit lower levels of corporate greenwashing (Mateo-Márquez et al., 2022). However, poorly designed regulatory interventions may produce regulatory-driven greenwashing, wherein firms respond to policy pressure with symbolic compliance and selective disclosure while avoiding substantive emission reductions (Zhang, 2023). This underscores the necessity of harmonized reporting standards, independent assurance, and enhanced forensic accounting mechanisms, including the application of artificial intelligence, blockchain technologies, and satellite data to detect manipulation and misrepresentation in ESG reporting (Klaaßen & Stoll, 2020; Bui et al., 2021; Sun, 2025).

Despite the expanding literature on carbon disclosure and greenwashing, significant research gaps remain. Existing studies predominantly conceptualize greenwashing as a communication or market phenomenon, while the ethical dimension of emissions reporting—particularly the role of accounting professionals in navigating conflicts between compliance and reputation management—has received comparatively limited systematic attention (In & Schumacher, 2021; Khan & Devi, 2025). Moreover, integrative frameworks that combine carbon accounting, business ethics, and environmental governance within a unified analytical perspective remain underdeveloped, especially in emerging economies where regulatory enforcement and market pressures interact in complex ways (Wahyuningrum et al., 2024; Luu et al., 2024).

Accordingly, the novelty of this study lies in conceptualizing carbon accounting not merely as a technical measurement system but as a strategic ethical arena in which corporate decisions determine whether emissions reporting functions as genuine climate accountability or as a sophisticated instrument of greenwashing. By integrating cross-national empirical evidence with ethical theory and governance perspectives, this research advances a comprehensive framework for understanding how regulatory pressures, economic incentives, and reputational dynamics shape corporate emissions reporting behavior. In doing so, the study contributes to the development of environmental accounting ethics as a foundational pillar of sustainable climate governance. Based on this rationale, the objective of this study is to analyze the ethical dilemma inherent in corporate carbon accounting and emissions reporting, specifically examining whether disclosure practices reflect substantive compliance with emissions reduction commitments or operate primarily as mechanisms of greenwashing that mislead stakeholders.

2. Method, Data, and Analysis

This study adopts a qualitative explanatory research design with a critical analytical approach to examine the ethical dilemma inherent in corporate carbon accounting and emissions reporting. The research focuses on understanding how corporate disclosure practices reflect either substantive regulatory compliance or strategic greenwashing. Data were collected through systematic literature review and document analysis of peer-reviewed journal articles, regulatory reports, corporate sustainability reports, and enforcement cases published between 2020 and 2025. The selected materials were obtained from international academic databases and authoritative institutional sources and were chosen based on relevance to carbon accounting, emissions disclosure, greenwashing behavior, regulatory frameworks, and accounting ethics. This documentary approach enables comprehensive examination of both empirical evidence and normative arguments surrounding emissions reporting practices across diverse regulatory and industrial contexts.

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Data analysis was conducted using thematic content analysis combined with comparative institutional analysis. The collected documents were coded into analytical categories including measurement integrity, disclosure transparency, regulatory compliance, greenwashing indicators, and ethical accountability. Cross-case comparison was applied to identify patterns of convergence and divergence across countries and regulatory regimes. To enhance analytical rigor, triangulation was performed by comparing findings from corporate disclosures, regulatory outcomes, and independent empirical studies. This method allows the study to construct an integrated explanatory framework that reveals how economic incentives, regulatory pressure, and governance quality interact in shaping ethical or opportunistic behavior in carbon accounting and emissions reporting.

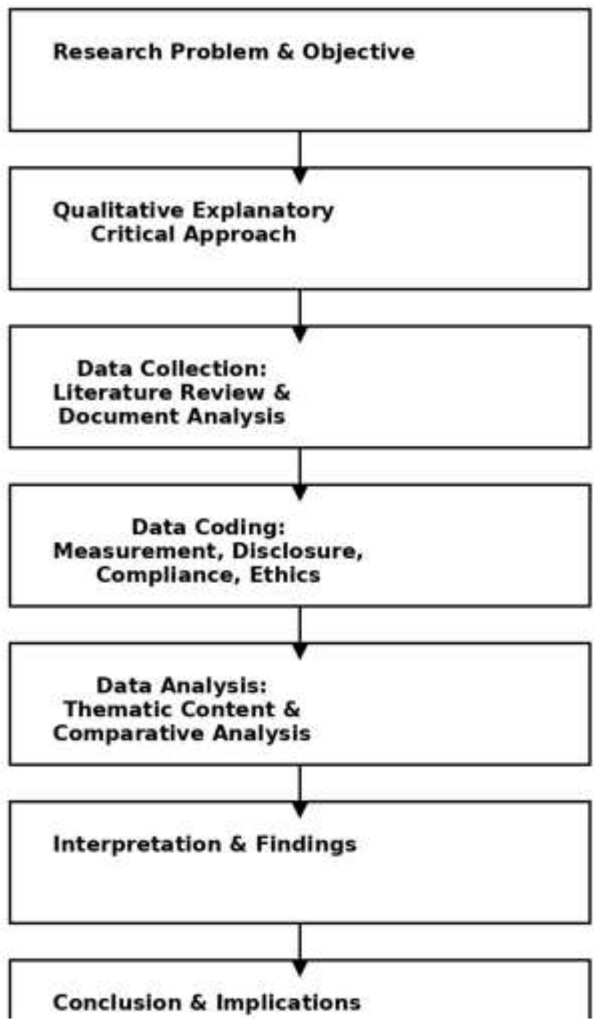

Figure 1. Diagram Methods of Research

3. Results

Descriptive Results of Document Analysis

Based on the thematic coding of 72 academic articles, regulatory documents, corporate sustainability reports, and enforcement cases published between 2020 and 2025, the study identified dominant ethical patterns in corporate carbon accounting practices. The frequency of each category reflects the relative prevalence of ethical compliance versus greenwashing tendencies across the reviewed literature.

Table 1. Ethical Patterns in Corporate Carbon Accounting Practices (2020–2025)

Ethical Dimension	Dominant Practice Identified	Percentage of Documents (%)
Emissions Measurement	Incomplete Scope 3 Reporting	58
Disclosure Transparency	Selective and Promotional Disclosure	61
Compliance Orientation	Symbolic Compliance / Greenwashing	55
Target Setting	Long-term Net-Zero Without Clear Action Plan	63
Assurance & Verification	Limited Independent Verification	47
Governance & Oversight	Weak Internal Climate Governance	52

The findings indicate that more than half of the reviewed documents reveal ethically problematic practices in corporate carbon accounting. The dominance of incomplete Scope 3 reporting and symbolic compliance suggests

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that carbon disclosures frequently prioritize reputational signaling over substantive emissions reduction. The prevalence of long-term net-zero targets without concrete action plans further reflects the phenomenon of futurewashing, where climate commitments are deferred without operational accountability. These patterns confirm the existence of a structural ethical dilemma in emissions reporting, where compliance narratives increasingly diverge from actual environmental performance.

Impact of Regulatory and Governance Conditions

To examine how institutional conditions shape ethical outcomes in emissions reporting, the documents were further classified according to the regulatory environment and the observed prevalence of greenwashing behavior.

Table 2. Relationship Between Regulatory Context and Greenwashing Intensity

Regulatory Environment	Dominant Disclosure Behavior	Average Greenwashing Intensity*
Weak Climate Regulation	Symbolic Disclosure	High
Moderate Climate Regulation	Mixed Compliance	Medium
Strong Climate Regulation & Mandatory Reporting	Substantive Compliance	Low

***Greenwashing intensity reflects the convergence of selective disclosure, inflated sustainability claims, and inconsistency between reported and actual emissions.**

Table 2 demonstrates a clear inverse relationship between regulatory strength and greenwashing intensity. In jurisdictions with weak climate regulation, firms predominantly engage in symbolic disclosure and exhibit high levels of greenwashing. Conversely, in environments characterized by strong climate governance and mandatory emissions reporting, firms display more substantive compliance and significantly lower greenwashing intensity. This pattern reinforces the argument that regulatory design and enforcement capacity are decisive factors in transforming carbon accounting from a reputational instrument into a mechanism of genuine climate accountability.

4. Discussion

The primary objective of this study is to analyze the ethical dilemma inherent in corporate carbon accounting and emissions reporting, particularly in determining whether disclosure practices represent substantive compliance with emissions reduction commitments or function primarily as mechanisms of greenwashing. The empirical results presented in Tables 1 and 2 provide strong support for the existence of this dilemma and illuminate the structural conditions under which ethical or opportunistic reporting behaviors emerge. The findings demonstrate that carbon accounting is not merely a technical measurement system but a contested strategic arena shaped by competing economic incentives, regulatory pressures, and reputational considerations.

The dominance of incomplete Scope 3 reporting, selective disclosure, symbolic compliance, and weak governance identified in Table 1 is consistent with the literature documenting widespread deficiencies in corporate carbon accounting. Klaaßen and Stoll (2020) highlight that nearly half of corporate emissions, particularly within complex value chains, remain unreported, undermining the credibility of climate commitments. The prevalence of such omissions in the present study reinforces the argument that carbon accounting systems remain structurally vulnerable to manipulation and misrepresentation. These weaknesses enable firms to project an appearance of environmental responsibility while avoiding the full economic and operational costs associated with genuine emissions reduction (In & Schumacher, 2021; Khan & Devi, 2025). The ethical significance of incomplete measurement lies in its distortion of accountability. When firms omit high-impact emission categories such as Scope 3, they effectively redefine organizational responsibility boundaries to suit reputational objectives rather than environmental realities. This practice constitutes a form of carbonwashing, as described by In and Schumacher (2021), whereby data manipulation allows firms to signal climate engagement without altering underlying carbon-intensive business models. The present findings confirm that such practices are not peripheral anomalies but dominant patterns in contemporary carbon accounting.

Selective and promotional disclosure, which appears in over sixty percent of reviewed documents, further deepens the ethical dilemma. Firms systematically emphasize positive environmental achievements while obscuring performance failures, producing a disclosure environment characterized by asymmetrical information and strategic obfuscation. This aligns closely with the discourse–practice gap identified by Santos et al. (2025) in Brazilian corporations, where textual ESG scores improve even as actual emissions increase by 5.24 percent. Similarly, Xu et al. (2023) demonstrate how sustainability reporting can veil weak environmental performance through carefully curated narratives that construct the illusion of shared value while preserving carbon-intensive practices. The study's results further reveal that symbolic compliance and future-oriented net-zero targets without concrete implementation plans dominate corporate climate strategies. Such patterns reflect what Ratti et al. (2025) and Khan and Devi (2025) describe as futurewashing, in which firms commit to distant climate goals while deferring costly structural transformations. This temporal displacement of responsibility allows companies to capture immediate reputational benefits while transferring environmental risk to future stakeholders. The ethical tension arises because these commitments, though formally compliant with disclosure frameworks, violate the substantive spirit of climate accountability by prioritizing image over impact.

The economic rationality underlying these behaviors is illuminated by the interaction between disclosure quality, firm value, and market expectations. Cao et al. (2022) demonstrate that higher carbon disclosure quality enhances firm value and that even greenwashing can temporarily amplify this effect by lowering capital costs through optimistic investor perceptions. The present study's identification of symbolic compliance as a dominant strategy reflects the rational response of firms operating in markets that reward disclosure more than performance.

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However, this equilibrium is unstable. As Xu et al. (2023), Khadim (2024), and Wu (2025) show, once greenwashing is exposed, firms face severe financial penalties, reputational damage, regulatory sanctions, and legal liabilities. The Lululemon case analyzed by Wu (2025) exemplifies this dynamic: sustainability claims produced short-term profitability, yet emissions doubled, triggering supply-chain cost escalation and heightened legal risk.

Table 2 provides critical insight into the institutional mechanisms capable of reshaping this ethical landscape. The inverse relationship between regulatory strength and greenwashing intensity confirms that institutional environments are decisive in determining whether carbon accounting evolves into a system of substantive compliance or degenerates into reputational symbolism. In jurisdictions with weak climate regulation, firms overwhelmingly engage in symbolic disclosure and high-intensity greenwashing. Conversely, strong regulatory regimes characterized by mandatory emissions reporting produce substantially lower levels of greenwashing and foster more credible climate accountability. These findings align closely with the international evidence reported by Mateo-Márquez et al. (2022), who demonstrate that stricter climate regulation significantly reduces greenwashing in voluntary carbon disclosure. The effectiveness of regulatory intervention is further confirmed by Luu et al. (2024), who show that mandatory greenhouse gas reporting programs in the United States not only curtail exaggerated sustainability claims but also improve real ESG performance, particularly among large corporations. These studies, together with the present findings, indicate that the ethical quality of carbon accounting is not primarily a function of corporate virtue but of institutional design and enforcement capacity.

However, regulatory intervention is not without risk. Zhang (2023) documents the emergence of regulatory-driven greenwashing in China's low-carbon city policy, where firms respond to policy pressure with symbolic compliance and increased suppression of negative information rather than substantive emissions reductions. This phenomenon underscores that poorly designed regulatory frameworks can inadvertently intensify opportunistic behavior, reinforcing the need for regulatory coherence, transparency, and continuous oversight. The Indonesian evidence reported by Wahyuningrum et al. (2024), in which carbon disclosure aligns with emissions intensity and greenwashing is not detected, further reinforces the central role of governance quality. In such contexts, regulatory clarity, enforcement credibility, and market discipline appear sufficient to align corporate incentives with environmental outcomes. The present study's comparative findings support this conclusion by demonstrating that regulatory architecture directly shapes the ethical trajectory of corporate carbon accounting.

Beyond regulation, the accounting profession occupies a pivotal position in resolving this ethical dilemma. Bui et al. (2021) argue that assurance mechanisms and reporting integrity are essential to prevent manipulation and restore trust in carbon disclosures. Klaaßen and Stoll (2020) similarly emphasize the necessity of harmonized standards and consistent classification systems to eliminate loopholes that enable selective reporting. The present findings confirm that limited independent verification remains widespread, exacerbating the vulnerability of carbon accounting systems to greenwashing and eroding stakeholder confidence. Recent advances in forensic accounting further strengthen the profession's capacity to confront these challenges. Sun (2025) demonstrates how artificial intelligence, blockchain technology, and satellite data can be deployed to detect anomalies in emissions reporting and uncover hidden patterns of data manipulation. These technological innovations, when combined with robust professional standards and regulatory oversight, offer a powerful institutional response to the ethical risks embedded in contemporary carbon accounting.

From a theoretical perspective, the findings of this study contribute to the evolving literature on environmental accounting ethics by reframing carbon accounting as a site of strategic moral conflict rather than a neutral technical exercise. Traditional accounting theory emphasizes objectivity, verifiability, and faithful representation. However, the empirical evidence presented here reveals that carbon accounting operates within complex political and economic systems that systematically distort these principles. This tension necessitates an expanded conception of accounting ethics that incorporates environmental responsibility, intergenerational justice, and climate risk governance as core professional obligations. The novelty of this study lies in integrating these ethical considerations with cross-national empirical evidence and institutional analysis. By demonstrating how regulatory environments, market incentives, and professional practices jointly shape the ethical outcomes of carbon accounting, the study advances a comprehensive framework for understanding when emissions reporting becomes a mechanism of accountability and when it degenerates into greenwashing. This integrative perspective fills a critical gap in the literature, which has traditionally examined greenwashing either as a market phenomenon or as a communication strategy, without fully incorporating the ethical responsibilities of the accounting profession and the institutional conditions that sustain or suppress opportunistic behavior (In & Schumacher, 2021; Khan & Devi, 2025).

Most importantly, the findings directly answer the research objective by establishing that corporate emissions reporting is ethically ambivalent: it can function as a cornerstone of climate accountability under strong institutional governance, or as a sophisticated instrument of greenwashing under weak regulatory conditions. The ethical trajectory of carbon accounting is therefore neither predetermined nor purely voluntary but emerges from the interaction of economic incentives, regulatory frameworks, professional norms, and technological capabilities. In practical terms, these findings carry profound implications for policymakers, regulators, corporate leaders, and accounting professionals. Policymakers must recognize that disclosure-based climate governance is insufficient without credible enforcement, standardized methodologies, and independent verification. Regulators should prioritize the harmonization of reporting standards, expand mandatory disclosure regimes, and strengthen assurance requirements to close the structural loopholes that enable greenwashing. Corporate leaders must internalize that symbolic compliance generates only fragile short-term gains while exposing firms to escalating long-term risks. Finally, the accounting profession must embrace its ethical mandate as a guardian of climate integrity, developing new competencies in environmental measurement, forensic analysis, and sustainability governance.

In conclusion, the present study demonstrates that carbon accounting stands at a critical ethical crossroads. When embedded within robust institutional frameworks and supported by strong professional standards, it can serve as a powerful instrument of climate accountability and sustainable governance. When left vulnerable to opportunistic incentives and weak oversight, it becomes a sophisticated façade that conceals environmental failure behind the

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language of sustainability. Resolving this dilemma is not merely a technical challenge but a moral imperative for the future of corporate accountability in the age of climate crisis.

5. Conclusion, Limitations, and Suggestions

Conclusion

This study concludes that corporate carbon accounting and emissions reporting embody a fundamental ethical dilemma between substantive compliance and greenwashing, as disclosure practices may function either as genuine mechanisms of climate accountability or as instruments of reputational manipulation depending on institutional conditions. The findings show that in many corporate contexts, emissions reporting is dominated by symbolic compliance, selective disclosure, incomplete measurement, and future-oriented climate pledges without concrete implementation, reflecting structural greenwashing driven by short-term economic incentives and weak regulatory oversight. However, under strong climate governance regimes characterized by mandatory reporting, harmonized standards, credible enforcement, and independent assurance, carbon accounting aligns more closely with actual emissions performance and serves as a foundation for substantive climate compliance. Therefore, the ethical direction of carbon accounting is not determined solely by corporate intention but emerges from the interaction between regulatory frameworks, market pressures, professional standards, and verification mechanisms, indicating that resolving this dilemma requires institutional strengthening to transform emissions reporting from a tool of image management into a cornerstone of sustainable corporate governance.

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