

From Sustainability Reporting to Natural Capital Valuation: Aligning ESG with Green Accounting

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Abstract: This study examines how environmental, social, and governance (ESG) frameworks can be aligned with green accounting principles in order to incorporate natural capital valuation into sustainability reporting. Although ESG has become a dominant mechanism for non-financial disclosure, its environmental dimension remains largely centered on standardized indicators, risk exposure, and firm-level performance. This limits its ability to capture the broader value, depletion, and long-term dynamics of natural capital. In contrast, green accounting provides a stronger basis for recognizing environmental stocks, ecosystem services, and ecological degradation, yet it remains insufficiently integrated into mainstream reporting systems. Using a qualitative and conceptual research approach based on structured literature analysis, this study identifies the main points of disconnect between the two approaches and explores their potential convergence. The findings suggest that a more coherent integration of ESG and green accounting is necessary to strengthen the analytical depth, ecological relevance, and strategic value of sustainability reporting.

Keywords: Corporate finance, ESG, green accounting, sustainability reporting, natural capital valuation.

1. Introduction

Sustainability has become a central concern in contemporary economic and governance systems, driven by the increasing recognition that environmental degradation, resource depletion, and climate-related risks pose fundamental challenges to long-term development (Doukas et al., 2025; Salvati et al., 2026). Within this evolving landscape, environmental, social, and governance (ESG) frameworks have emerged as dominant instruments for structuring sustainability reporting and guiding corporate behavior (Vardopoulos & Passas, 2025). By translating environmental and social considerations into measurable indicators, ESG has enabled the integration of sustainability into financial markets, investment strategies, and regulatory processes. Its rapid institutionalization reflects a broader shift toward the quantification of non-financial performance, where transparency, comparability, and accountability are prioritized as key elements of sustainable value creation (Bin-Nashwan, 2026; Petelos et al., 2025).

Despite this progress, important conceptual limitations remain. ESG frameworks are primarily designed as disclosure mechanisms, structured around firm-level reporting and materiality principles that emphasize investor relevance. As a result, environmental issues are often represented through standardized metrics that capture performance and risk exposure but do not fully reflect the underlying dynamics of natural systems. This creates a partial representation of sustainability, in which complex ecological processes are reduced to indicators that are measurable and comparable, yet insufficiently connected to the broader concept of environmental value. In this context, sustainability reporting risks becoming procedurally advanced while remaining conceptually incomplete (Parra-Domínguez et al., 2026).

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At the same time, the growing prominence of natural capital within environmental economics and policy debates has highlighted the limitations of conventional accounting systems in capturing ecological value. Natural capital refers to the stock of environmental assets that generate essential goods and services, forming the biophysical foundation of economic activity. The depletion and degradation of these assets represent not only environmental concerns but also economic losses that remain largely unaccounted for in traditional reporting frameworks (Kopsidas et al., 2026; Salvati et al., 2025). Green accounting emerges as a response to this gap, seeking to incorporate environmental stocks, ecosystem services, and long-term ecological change into economic measurement. Unlike ESG, which focuses on disclosure, green accounting is fundamentally concerned with valuation, offering a framework through which environmental change can be systematically recognized and assessed.

However, despite their shared relevance to sustainability, ESG and green accounting have developed largely in parallel rather than in an integrated manner. ESG dominates the field of corporate reporting due to its standardization and institutional adoption, while green accounting remains more conceptually advanced but less operationalized within mainstream practices. This separation has significant implications. ESG frameworks provide the structure through which sustainability information is communicated, yet they lack the depth required to fully incorporate natural capital. Conversely, green accounting offers the necessary valuation logic but lacks the institutional mechanisms needed for widespread implementation. The absence of alignment between these approaches creates a critical gap in sustainability reporting, where environmental value is acknowledged but not comprehensively measured (Free et al., 2025; Shahzad et al., 2022).

This gap is particularly important in the context of increasing regulatory and policy pressure for more robust sustainability disclosures. Developments such as the Corporate Sustainability Reporting Directive (CSRD) and the International Sustainability Standards Board (ISSB) signal a movement toward greater standardization and comparability, yet they do not fully resolve the challenge of integrating natural capital into reporting systems. As sustainability reporting continues to evolve, the need for a framework that connects disclosure with valuation becomes increasingly evident. Without such integration, sustainability metrics risk remaining disconnected from the ecological realities they are intended to represent (Fornasari & Traversi, 2024).

In light of these considerations, this study addresses the need for a more coherent relationship between ESG frameworks and green accounting principles. It argues that advancing sustainability reporting requires not only improved disclosure practices but also the systematic incorporation of natural capital valuation into existing frameworks. By examining the conceptual and methodological gaps between ESG and green accounting, the study seeks to contribute to the development of a more integrated approach to sustainability measurement. Accordingly, the research is guided by the following question: How can ESG frameworks be effectively aligned with green accounting principles to incorporate natural capital valuation into sustainability reporting?

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on ESG frameworks, green accounting, and their potential integration, identifying key gaps and limitations. Section 3 outlines the methodological approach of the study. Section 4 presents the results of the analysis, focusing on the relationship between existing frameworks and their connections. Section 5 discusses the implications of the findings and concludes the study, while Section 6 identifies directions for future research.

2. Literature Review

2.1. ESG Frameworks and Sustainability Reporting

ESG frameworks have become one of the most influential mechanisms through which sustainability is translated into corporate reporting, strategic governance, and investment evaluation. Their rise reflects a structural shift in the understanding of corporate performance, in which financial results are no longer treated as sufficient indicators of long-term value creation. Instead, environmental exposure, social legitimacy, and governance quality are increasingly viewed as factors that shape resilience, risk, and competitiveness (Kavouras et al., 2022; Vortelinos et al., 2026). In this context, ESG reporting has moved beyond a peripheral disclosure exercise and has become closely connected to capital allocation, stakeholder scrutiny, and regulatory oversight. What distinguishes ESG from earlier sustainability narratives is not simply its concern with non-financial issues, but its effort to render such issues measurable, comparable, and decision-useful within institutional and market settings (Passas, 2024).

This development was not linear. ESG emerged through the convergence of corporate social responsibility (CSR) reporting, socially responsible investment (SRI) practices, climate disclosure initiatives, and wider demands for corporate transparency. Over time, this convergence generated a reporting architecture in which sustainability became formalized through indicators, benchmarks, and materiality assessments. Frameworks such as the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), the Task Force on Climate-related Financial Disclosures (TCFD), and later the ISSB and the CSRD played a central role in this process by shaping what counts as relevant sustainability information and how that information should be communicated. Yet the consolidation of these frameworks did not eliminate fragmentation. On the contrary, it often produced overlapping standards, inconsistent metrics, and different interpretations of materiality. As a result, ESG reporting has grown in volume and visibility, but not always in conceptual coherence (Eccles et al., 2020; Passas & Garefalakis, 2025).

A central feature of ESG is that it organizes sustainability around the reporting entity. The firm is treated as the primary unit of analysis, and environmental performance is generally assessed through indicators linked to operational efficiency, emissions management, resource use, climate risk, and compliance (Loizia et al., 2021). This firm-centered logic has made ESG highly adaptable to financial markets because it aligns sustainability disclosure with investor-oriented assessment. However, the same logic also narrows the analytical scope of sustainability by privileging what can be attributed to the boundaries of the corporation. Environmental questions are therefore often reduced to manageable categories of exposure and performance, while broader ecological interdependencies remain weakly represented. This limitation becomes especially significant when the subject under examination involves natural systems whose functions cannot be meaningfully understood through isolated organizational metrics alone (Chen et al., 2025; Li et al., 2021).

The environmental pillar of ESG is particularly affected by this reductionist tendency. Although it has expanded substantially in recent years, much of its operational structure remains dominated by carbon accounting, energy transition indicators, waste management, and selected resource-efficiency measures. These are important dimensions, but they do not exhaust the environmental domain. Natural capital degradation, ecosystem integrity, biodiversity loss, hydrological disruption, and cumulative ecological thresholds are often addressed unevenly or indirectly. Even where such issues appear in sustainability disclosures, they are frequently incorporated through proxy indicators that capture managerial response rather than ecological condition (Vardopoulos et al., 2026). In other words, ESG often measures what firms report doing about environmental problems rather than what is happening to the underlying ecological systems on which economic activity depends.

This points to a deeper conceptual issue. ESG does not merely report sustainability; it constructs a particular version of sustainability through its metrics and disclosure logics. What becomes visible within ESG is strongly conditioned by materiality filters, assurance practices, reporting incentives, and the priorities of financial audiences (Vortelinos & Papaioannou, 2025). Consequently, environmental harm that is diffuse, long-term, spatially distributed, or difficult to monetize tends to remain weakly integrated. The problem is not simply one of incomplete data, but of epistemic design. ESG frameworks are highly effective at organizing sustainability information around risk, governance, and disclosure discipline, yet they are less effective at representing ecological complexity, systemic deterioration, and non-linear environmental change. This creates a gap between the apparent sophistication of sustainability reporting and the narrower ontology through which environmental value is recognized (Lemonakis et al., 2016).

Another important limitation concerns the distinction between impact materiality and financial materiality. In practice, ESG reporting has often been driven by the question of how environmental change affects the firm, rather than how the firm affects environmental systems. Even in contexts where double materiality is gaining ground, the reporting structure frequently remains asymmetrical. Financially material issues receive greater methodological development, clearer indicators, and stronger institutional uptake than impacts that are ecologically significant but not immediately priced by markets. This asymmetry has major implications for the treatment of natural capital. If environmental value is acknowledged primarily when it translates into financial risk, then ecosystem degradation is filtered through corporate vulnerability rather than assessed as a substantive depletion of shared ecological assets. Such an approach cannot adequately support a more comprehensive understanding of sustainability, especially where environmental damage accumulates gradually and becomes visible only after thresholds have been crossed (A. Garefalakis et al., 2025; S. Garefalakis et al., 2025).

The expansion of ESG into mainstream governance has therefore produced a paradox. On the one hand, it has increased the legitimacy of sustainability reporting, normalized non-financial disclosure, and created new mechanisms for

accountability. On the other hand, its institutional success has reinforced a reporting model in which environmental reality is selectively translated into corporate metrics. This translation is not neutral. It privileges standardization over ecological specificity, comparability over contextual depth, and disclosure efficiency over system-level understanding. As a result, ESG frameworks often provide a structured account of corporate sustainability performance while leaving unresolved the question of how natural capital is to be recognized, valued, and protected within reporting systems that remain largely anchored in organizational boundaries and investor relevance (Angelaki et al., 2025).

These tensions are especially important for the broader debate on sustainability reporting because they reveal that disclosure alone is not equivalent to environmental accountability. The existence of ESG metrics does not guarantee that ecological degradation is meaningfully captured, nor does reporting standardization ensure that environmental value is conceptually integrated into decision-making. Where natural capital is treated as an external context rather than as a foundational condition of economic production, sustainability reporting risks becoming procedurally advanced but substantively partial. For this reason, the growing authority of ESG should not be interpreted as evidence that the environmental dimension of corporate reporting has been fully resolved. Rather, it should be seen as an important but incomplete stage in the evolution of sustainability governance.

From this perspective, the significance of ESG lies both in what it has achieved and in what it still cannot fully incorporate. It has created an institutional language through which sustainability can enter corporate and financial practice, but it continues to struggle with the valuation of ecological systems that exceed firm-level accounting boundaries. This unresolved tension is central to the present study. If sustainability reporting is to move beyond disclosure-based representations of environmental performance, it must engage more directly with the logic of green accounting and the valuation of natural capital. The limitations of ESG are therefore not grounds for dismissal, but grounds for conceptual extension. Its current architecture provides the reporting infrastructure, yet a more ecologically grounded framework is required if sustainability reporting is to reflect not only organizational conduct but also the condition and depletion of the natural systems upon which economic life depends (Krasteva-Hristova et al., 2025; Sariannidis et al., 2021).

2.2. Conceptual Foundations of Green Accounting

Green accounting emerges from the recognition that conventional accounting systems systematically exclude the value, depletion, and degradation of natural systems from economic measurement. Traditional financial accounting is structured around transactions, prices, and market-based exchanges, which means that environmental assets are only recorded when they enter the economy in monetized form. As a result, the extraction of resources, the use of ecosystem functions, and the absorption of waste are largely treated as external to accounting boundaries. This exclusion creates a fundamental distortion; whereby economic performance can appear positive even when it is achieved through the irreversible depletion of natural capital. Green accounting develops as a corrective response to this distortion, seeking to extend accounting logic beyond financial capital to include the ecological foundations upon which economic activity depends (Cornell, 2020).

At its core, green accounting is grounded in the concept of natural capital. Natural capital refers to the stock of environmental assets that generate flows of goods and services over time, including provisioning, regulating, and supporting functions. Unlike financial or manufactured capital, natural capital is characterized by ecological interdependence, non-linearity, and threshold effects. Its value cannot be fully understood through static measurement, as it is embedded in dynamic systems that evolve across spatial and temporal scales. This introduces a fundamental tension within accounting practice. While accounting traditionally relies on clear boundaries, discrete units, and standardized valuation methods, natural capital resists such simplification due to its systemic and often non-market nature. Green accounting therefore requires a reconfiguration of accounting principles to accommodate complexity, uncertainty, and ecological interconnection (Sun & Chen, 2025).

The theoretical foundations of green accounting are closely linked to ecological economics, which challenges the assumption that the economy can be treated as an autonomous system. Instead, economic activity is understood as a subsystem embedded within the environment, dependent on continuous inputs of energy and materials and constrained by biophysical limits. From this perspective, the depletion of natural capital is not merely an environmental issue but a fundamental economic concern. Green accounting adopts this logic by attempting to make visible the environmental costs and dependencies that remain hidden in conventional accounts. This involves not only recognizing environmental

degradation as a form of capital consumption, but also conceptualizing ecosystems as productive assets whose capacity to generate services can be diminished over time (Lokuwaduge & De Silva, 2022; Risso & Longarini, 2023).

A central component of green accounting is the valuation of ecosystem services. These services represent the benefits that human societies derive from natural systems, ranging from resource provision to climate regulation and waste assimilation. However, assigning value to such services presents significant conceptual and methodological challenges. Many ecosystem functions do not have market prices and, even when valuation techniques are applied, they often rely on assumptions that are sensitive to context, scale, and methodological choice. This raises important questions about commensurability, as diverse ecological functions are translated into monetary units that may not adequately capture their qualitative and systemic significance. Green accounting does not resolve these challenges entirely, but it seeks to create a framework in which such values can at least be partially recognized and incorporated into economic analysis (Free et al., 2025).

Another defining feature of green accounting is its attempt to move from flow-based to stock-based perspectives. Conventional accounting tends to emphasize flows of income, expenditure, and output, whereas green accounting places greater emphasis on the condition and evolution of underlying stocks of natural capital. This shift is crucial because it highlights the sustainability of economic activity over time. An economy may generate high levels of output in the short term while simultaneously eroding the natural assets that support future production (Salvati et al., 2025). By focusing on changes in natural capital stocks, green accounting introduces the possibility of identifying unsustainable trajectories that remain invisible within standard financial metrics. This perspective also aligns with broader sustainability concerns, as it connects economic performance to long-term ecological viability (Lokuwaduge & De Silva, 2022; Rossi et al., 2025).

Despite its conceptual strength, green accounting faces significant barriers to implementation. One of the main challenges is the lack of standardized methodologies that can be consistently applied across contexts. While frameworks such as the System of Environmental-Economic Accounting (SEEA) have made important contributions by providing structured approaches to environmental-economic accounting, their integration into corporate reporting and decision-making remains limited. In practice, green accounting often operates at the level of national accounts or experimental satellite accounts, rather than being embedded within the routine financial practices of firms. This creates a disconnect between the conceptual recognition of natural capital and its operationalization within mainstream accounting systems (Maneekul, 2024).

Furthermore, green accounting requires a redefinition of what constitutes value in economic terms. Traditional accounting is closely aligned with market valuation and shareholder-oriented perspectives, whereas green accounting introduces broader notions of value that include ecological integrity, resilience, and long-term sustainability (Panagiotopoulos et al., 2024). These dimensions are not easily reconciled with existing financial logics, particularly in contexts where short-term performance and comparability are prioritized. As a result, green accounting is often perceived as supplementary rather than integral, despite its potential to fundamentally reshape the way economic activity is measured and evaluated (Uru et al., 2026; White et al., 2025).

The conceptual foundations of green accounting therefore reveal both its transformative potential and its structural limitations. It offers a framework capable of capturing the economic significance of natural systems, yet it operates within an institutional environment that is not fully adapted to its principles. This tension is central to the broader challenge of sustainability reporting. While green accounting provides the valuation logic necessary to recognize natural capital, it lacks the widespread institutional embedding that characterizes ESG frameworks. Conversely, ESG has achieved significant diffusion and influence, but without fully incorporating the depth of environmental valuation that green accounting proposes. The relationship between the two is thus not one of substitution but of complementarity, where each addresses dimensions that the other leaves underdeveloped.

Understanding these conceptual foundations is essential for advancing the integration of sustainability into accounting and reporting practices. Green accounting does not simply add environmental variables to existing systems; it challenges the underlying assumptions about value, measurement, and the relationship between the economy and the environment. By doing so, it creates the conditions for a more comprehensive representation of sustainability, one in which natural capital is not treated as an externality but as a central component of economic analysis. This reorientation provides the necessary conceptual basis for examining how green accounting can be aligned with, and ultimately embedded within, the reporting structures that currently dominate sustainability practice.

2.3. Bridging ESG and Green Accounting

The relationship between ESG frameworks and green accounting is increasingly recognized as central to the advancement of sustainability reporting, yet their integration remains conceptually incomplete and institutionally underdeveloped. While both approaches seek to address the environmental dimension of economic activity, they originate from fundamentally different logics. ESG is primarily structured as a disclosure and governance mechanism, designed to standardize the communication of sustainability-related risks and performance at the firm level. Green accounting, by contrast, is grounded in valuation, aiming to incorporate the depletion and regeneration of natural capital into economic measurement. The challenge of bridging these approaches lies not only in aligning their methodologies but in reconciling their underlying assumptions about value, scale, and the purpose of accounting.

At a structural level, ESG operates through indicators that translate environmental concerns into metrics suitable for reporting, benchmarking, and investment analysis. These metrics are shaped by materiality frameworks, regulatory pressures, and the expectations of financial markets, which prioritize comparability and decision-usefulness. Green accounting introduces a different orientation by emphasizing the quantification of environmental stocks and flows, often extending beyond market-based valuation to capture ecosystem functions and long-term ecological change. The tension between these approaches becomes evident in the way environmental information is treated. ESG tends to privilege standardized, firm-specific disclosures, whereas green accounting requires system-level assessments that may not align with corporate boundaries or reporting cycles (Pace et al., 2025). Bridging the two therefore requires a shift from parallel coexistence toward conceptual integration, where reporting and valuation are understood as mutually reinforcing rather than separate domains (Tumewang et al., 2025).

One of the key obstacles to integration is the mismatch between reporting units and ecological systems. ESG frameworks are designed around organizational entities, while natural capital is distributed across interconnected systems that transcend corporate control. This creates a fragmentation in how environmental impacts are captured. A firm may report reductions in emissions or improvements in resource efficiency, yet such disclosures provide limited insight into cumulative environmental change or the condition of the ecosystems affected by its operations (D'Agata et al., 2023). Green accounting addresses this issue by focusing on the integrity and evolution of natural capital stocks, but it lacks the institutional mechanisms that would embed such assessments within routine corporate reporting. Bridging ESG and green accounting therefore requires the development of approaches that can translate system-level environmental change into information that is both relevant and actionable within firm-level reporting structures (da Cunha et al., 2025).

Another dimension of the integration challenge concerns the treatment of value. ESG frameworks often rely on proxy indicators and qualitative disclosures to represent environmental performance, particularly in areas where measurement is complex or data are limited. While this allows for flexibility and broader coverage, it also limits the capacity of ESG to reflect the economic significance of environmental degradation. Green accounting, on the other hand, seeks to assign value to natural capital through monetary and non-monetary methods, thereby making environmental change visible within economic analysis. However, these valuation approaches are frequently contested and difficult to standardize, which has constrained their adoption within mainstream reporting. Bridging the two approaches involves not only incorporating valuation into ESG metrics, but also addressing the epistemic challenges associated with measuring ecological value in ways that are credible, comparable, and decision-relevant (Huiping et al., 2024; Papamichael et al., 2023).

Recent developments suggest a growing convergence between ESG and green accounting, particularly within regulatory and standard-setting contexts. Initiatives such as the ISSB and the CSRD have begun to expand the scope of sustainability reporting, introducing more detailed environmental disclosures and encouraging greater alignment with broader sustainability objectives. At the same time, frameworks such as the SEEA have advanced the formalization of environmental-economic accounting at the national level, providing methodological foundations for the measurement of natural capital. Despite these advances, integration remains partial. ESG continues to dominate corporate reporting practices, while green accounting remains more influential in policy and statistical domains. The absence of a unified framework that connects these levels of analysis limits the capacity of sustainability reporting to capture the full extent of environmental value and change (Shih et al., 2026).

A further challenge lies in the temporal dimension of sustainability. ESG reporting is typically structured around annual disclosure cycles, which align with financial reporting practices but may not reflect the longer-term dynamics of ecological

systems. Natural capital evolves over extended time horizons, often exhibiting delayed responses, cumulative effects, and irreversible thresholds (Maialetti et al., 2024). Green accounting is more attuned to these dynamics, yet its insights are not easily incorporated into short-term reporting frameworks. Bridging ESG and green accounting therefore requires an expansion of temporal perspectives within sustainability reporting, allowing for the integration of long-term environmental change into decision-making processes that are often driven by shorter-term considerations (Abela, 2022; Wagenhofer, 2024).

The integration of ESG and green accounting is not merely a technical exercise but a conceptual reorientation of sustainability reporting. It involves moving beyond a model in which environmental information is disclosed primarily for compliance or risk management purposes, toward one in which natural capital is recognized as a fundamental component of economic value. This shift requires rethinking the boundaries of accounting, the definition of materiality, and the role of valuation in representing environmental change. It also necessitates the development of interdisciplinary approaches that draw on insights from accounting, economics, and environmental science, reflecting the complexity of the systems being measured (Krasteva-Hristova et al., 2025; Stocker et al., 2020).

Ultimately, bridging ESG and green accounting highlights both the progress that has been made in sustainability reporting and the limitations that remain. ESG provides the institutional infrastructure and widespread adoption necessary for integrating sustainability into corporate practice, while green accounting offers the conceptual tools required to capture the value and dynamics of natural capital. Their integration has the potential to produce a more comprehensive and coherent framework, one that aligns financial systems with ecological realities. However, achieving this integration requires addressing persistent challenges related to measurement, scale, standardization, and institutional adoption. Until these challenges are resolved, the relationship between ESG and green accounting will remain characterized by partial alignment rather than full conceptual coherence, underscoring the need for continued theoretical and practical development in this field.

2.4. Synthesis and Research Gap

The preceding discussion reveals that, despite the rapid institutionalization of ESG frameworks and the conceptual advancement of green accounting, a fundamental disconnect persists between sustainability reporting practices and the valuation of natural capital. ESG has succeeded in establishing a widely accepted architecture for non-financial disclosure, embedding environmental considerations into corporate governance and financial decision-making. However, its operational logic remains predominantly centered on firm-level metrics, materiality filters, and standardized indicators that prioritize comparability and investor relevance. In doing so, it captures selected dimensions of environmental performance but falls short of representing the complexity, interdependence, and long-term dynamics of natural systems.

In parallel, green accounting provides a theoretically robust foundation for incorporating environmental value into economic analysis by emphasizing natural capital stocks, ecosystem services, and the costs of ecological degradation. It challenges the exclusion of environmental externalities from conventional accounting and introduces valuation approaches capable of revealing the economic significance of natural systems. Yet, despite its conceptual depth, green accounting remains only partially integrated into mainstream reporting practices. Its methodologies are often applied at macro or experimental levels, while its translation into firm-level reporting frameworks is limited by issues of standardization, data availability, and institutional adoption.

The coexistence of these two approaches has not resulted in meaningful convergence. Instead, ESG and green accounting operate largely in parallel, each addressing different dimensions of sustainability without achieving conceptual alignment. ESG structures how sustainability is disclosed, but not how environmental value is fundamentally measured. Green accounting advances how natural capital can be valued, but not how such valuation can be systematically embedded within widely adopted reporting systems. This separation creates a critical gap in sustainability reporting, where environmental information is increasingly visible yet remains only partially reflective of underlying ecological realities.

A central implication of this gap is the absence of a coherent framework capable of linking disclosure with valuation. Current ESG practices tend to rely on proxy indicators and performance metrics that do not fully account for the depletion or regeneration of natural capital. At the same time, green accounting approaches, while capable of capturing such changes, are not sufficiently operationalized within the structures that govern corporate reporting and investment analysis. This

misalignment limits the capacity of sustainability reporting to function as a tool for accurately representing environmental value and guiding decision-making toward long-term ecological sustainability.

Moreover, the lack of integration reflects deeper conceptual tensions regarding the boundaries of accounting, the definition of materiality, and the role of environmental valuation. ESG frameworks are shaped by financial materiality and reporting efficiency, whereas green accounting is grounded in ecological integrity and system-level assessment. Without a framework that reconciles these perspectives, sustainability reporting risks remaining fragmented, with disclosure practices advancing independently from valuation methodologies. This fragmentation not only constrains analytical coherence but also weakens the potential of sustainability reporting to inform policy, corporate strategy, and resource allocation in a manner consistent with environmental limits.

In light of these limitations, there is a clear need to move beyond the parallel development of ESG and green accounting toward their conceptual and methodological alignment. Addressing this need requires a framework that integrates the institutional strengths of ESG with the valuation principles of green accounting, enabling natural capital to be systematically incorporated into sustainability reporting. It is precisely this unresolved challenge that motivates the present study. Accordingly, this research is guided by the following question:

RQ1: How can ESG frameworks be effectively aligned with green accounting principles to incorporate natural capital valuation into sustainability reporting?

3. Methodology

This study adopts a qualitative and conceptual research approach in order to examine the alignment between ESG frameworks and green accounting principles in the context of natural capital valuation. Rather than relying on primary data collection or empirical testing, the research is grounded in the systematic analysis and synthesis of existing academic literature, institutional reports, and established sustainability frameworks. This approach is considered appropriate given the exploratory and integrative nature of the research question, which seeks to address conceptual and methodological gaps within an evolving field of inquiry (Heim et al., 2026; Tang, 2023).

The methodological foundation of the study is based on a structured literature review, designed to capture the key theoretical developments and practical applications related to ESG reporting, green accounting, and natural capital. The selection of sources prioritizes peer-reviewed journal articles, policy documents, and standard-setting frameworks that have significantly influenced the development of sustainability reporting practices. Particular attention is given to widely recognized frameworks such as GRI, SASB, TCFD, ISSB, and CSRD, as well as environmental-economic accounting systems such as SEEA, in order to ensure that the analysis reflects both academic discourse and institutional practice. The review process focuses on identifying dominant themes, methodological approaches, and areas of convergence and divergence across these bodies of literature.

The analytical strategy employed in this study is interpretive and comparative in nature. Existing frameworks are examined not in isolation but in relation to one another, with the aim of identifying underlying assumptions, structural limitations, and points of conceptual misalignment. ESG frameworks are analyzed in terms of their role in standardizing sustainability disclosure and shaping corporate reporting practices, while green accounting is examined with respect to its capacity to capture the value and dynamics of natural capital. Through this comparative lens, the study seeks to uncover the extent to which current approaches succeed or fail in integrating environmental valuation into reporting systems. This process enables the identification of critical gaps, particularly those arising from differences in scale, measurement logic, and the treatment of environmental value (Farag, 2025; Lemonakis et al., 2018).

Building on this analysis, the study develops a conceptual framework that aims to bridge ESG and green accounting by aligning their respective strengths. The framework is not intended as a prescriptive model for immediate implementation, but rather as an analytical structure that clarifies how natural capital valuation can be systematically incorporated into sustainability reporting. In this sense, the methodology extends beyond descriptive review and engages in theory-building, contributing to the advancement of knowledge by proposing a more integrated perspective on sustainability accounting. The development of the framework is grounded in the synthesis of insights derived from the literature, ensuring that it reflects both established concepts and identified gaps (Bais et al., 2024; Farisiy et al., 2022).

The scope of the study is inherently constrained by its conceptual orientation. As the analysis does not involve empirical validation, the proposed framework remains theoretical and requires further testing in applied contexts. In addition, the study is dependent on the availability and interpretation of existing literature, which may reflect particular disciplinary biases or evolving standards. Despite these limitations, the chosen methodology allows for a rigorous and coherent examination of the relationship between ESG and green accounting, providing a foundation for future empirical research and practical application.

4. Results

The analysis reveals that ESG frameworks and green accounting approaches, while often positioned within the same sustainability discourse, operate through fundamentally different yet potentially complementary logics. ESG frameworks function primarily as structured disclosure systems, translating environmental and social considerations into standardized indicators that can be integrated into corporate reporting and financial decision-making. Their strength lies in their institutionalization, comparability, and widespread adoption, which enable sustainability to be operationalized within governance structures and capital markets. However, this operational strength is achieved through a reduction of environmental complexity into measurable and reportable units, often constrained by firm-level boundaries and materiality filters. As a result, ESG provides a consistent language of disclosure but only a partial representation of environmental value (Jauernig & Valentinov, 2019; Sneideriene & Legenzova, 2026).

In contrast, green accounting introduces a valuation-based perspective that seeks to capture the economic significance of natural capital by accounting for its depletion, regeneration, and systemic functions (Kopsidas et al., 2026). Rather than focusing on disclosure, it emphasizes the measurement of environmental stocks and flows, extending the scope of accounting to include ecological assets that are typically excluded from financial systems. This approach allows for a more comprehensive representation of environmental value, particularly in relation to long-term sustainability and ecosystem integrity. However, the analysis indicates that green accounting lacks the institutional embedding and standardization that characterize ESG frameworks, limiting its integration into routine corporate reporting practices.

The results highlight that the relationship between ESG and green accounting is not characterized by redundancy but by structural misalignment. ESG frameworks are designed to answer questions related to performance, risk, and transparency at the organizational level, whereas green accounting addresses the valuation of environmental systems that transcend organizational boundaries. This difference in analytical scale creates a disconnect in how environmental information is generated and interpreted. ESG metrics often capture operational impacts in isolation, without adequately reflecting cumulative effects or the condition of underlying natural capital. Green accounting, by contrast, provides the conceptual tools to assess such conditions but does not offer mechanisms for their consistent incorporation into firm-level disclosures (Cardillo & Basso, 2025; Li et al., 2021; Passas & Garefalakis, 2025).

A key finding of the analysis is that ESG's reliance on indicators and proxy measures limits its capacity to internalize environmental value in a substantive manner. Environmental performance within ESG is frequently expressed through metrics such as emissions intensity, resource efficiency, or compliance-related disclosures, which reflect managerial responses rather than ecological outcomes. While these indicators are useful for benchmarking and comparability, they do not fully account for the depletion of natural capital or the degradation of ecosystem functions. Comparable discrepancies between standardized assessment instruments and observed outcomes have been documented in other sustainability domains, underlining the limits of purely indicator-based evaluation (Vardopoulos et al., 2024; Vassiliades et al., 2025). Green accounting addresses this limitation by introducing valuation approaches that attempt to quantify environmental change, yet these approaches remain methodologically complex and insufficiently standardized for widespread adoption within ESG reporting structures.

The analysis further demonstrates that temporal misalignment constitutes a significant barrier to integration. ESG reporting is typically aligned with annual disclosure cycles and short- to medium-term risk assessments, reflecting the temporal logic of financial reporting. In contrast, green accounting is inherently oriented toward long-term changes in natural capital stocks, including processes that unfold over extended periods and may involve delayed or non-linear impacts (Maialetti et al., 2024). This divergence limits the ability of ESG frameworks to capture the long-term consequences

of environmental degradation, even when such consequences are recognized within green accounting methodologies (Krasteva-Hristova et al., 2025; Papafloratos et al., 2025).

Despite these differences, the results indicate clear points of potential convergence. ESG frameworks provide the institutional infrastructure, regulatory momentum, and standardized formats necessary for embedding sustainability into corporate practice. Green accounting contributes the conceptual and methodological depth required to integrate natural capital valuation into these structures. The connection between the two can therefore be understood as a relationship between disclosure and valuation, where ESG offers the mechanism for reporting and green accounting provides the content necessary for a more comprehensive representation of environmental value. However, this connection remains underdeveloped, as current ESG practices do not systematically incorporate the valuation principles that underpin green accounting (Free et al., 2025; Maneekul, 2024).

The findings also suggest that existing frameworks such as GRI, TCFD, ISSB, and CSRD create partial entry points for integration but do not fully resolve the underlying conceptual gap. These frameworks expand the scope of environmental disclosure and improve the consistency of reporting (Bais et al., 2024; Fornasari & Traversi, 2024), yet they continue to rely on indicator-based approaches that do not adequately capture the dynamics of natural capital. Similarly, systems such as SEEA provide structured methodologies for environmental-economic accounting but remain largely disconnected from corporate reporting processes. The absence of a unifying structure that links these frameworks reinforces the fragmentation identified in the literature. The relationships between the principal ESG and green accounting frameworks, as well as their respective roles in shaping disclosure and valuation practices, are summarized in Table 1, highlighting the structural disconnect and potential points of integration.

Overall, the results demonstrate that the current landscape of sustainability reporting is characterized by a coexistence of advanced disclosure systems and underutilized valuation methodologies. ESG and green accounting address different dimensions of the same problem, yet their lack of integration limits the capacity of sustainability reporting to reflect environmental reality in a coherent and meaningful way. This misalignment underscores the need for a conceptual framework that can bridge the gap between reporting and valuation, aligning ESG metrics with green accounting principles in order to incorporate natural capital as a central component of sustainability reporting.

Table 1. Key Frameworks and their Connections in ESG and Green Accounting Integration

Framework	Domain	Core function	Connection to ESG	Connection to green accounting	Integration role
GRI	ESG Reporting	Broad sustainability disclosure	Provides environmental indicators and impact reporting	Limited direct valuation; mainly qualitative and metric-based	Entry point for environmental disclosure
SASB	ESG Reporting	Industry-specific financial materiality	Aligns ESG with investor-focused metrics	Does not incorporate natural capital valuation	Links ESG to financial performance
TCFD	ESG / Climate	Climate risk disclosure	Integrates environmental risk into governance and strategy	Indirect; does not measure natural capital stocks	Connects environmental risk with financial systems
ISSB	ESG Standardization	Global baseline sustainability reporting	Harmonizes ESG disclosures across markets	Limited valuation integration	Standardization platform for future integration
CSRD	ESG Regulation (EU)	Mandatory sustainability reporting	Expands ESG scope and introduces double materiality	Creates space for natural capital considerations	Regulatory driver for integration
SEEA	Green Accounting	Environmental-economic accounting	Not designed for corporate ESG reporting	Core framework for natural capital valuation and ecosystem accounting	Provides valuation structure
Natural Capital Protocol	Green Accounting	Natural capital assessment	Can inform ESG disclosures on environmental impacts	Directly supports valuation and decision-making	Bridge between corporate practice and valuation
EU Taxonomy	ESG / Policy	Classification of sustainable activities	Defines what qualifies as environmentally sustainable	Indirectly linked to environmental value and thresholds	Aligns reporting with sustainability objectives

5. Discussion and Conclusions

The findings of this study highlight that the current architecture of sustainability reporting is characterized by a structural imbalance between disclosure and valuation. ESG frameworks have achieved a high degree of institutional consolidation, providing standardized mechanisms through which environmental and social information is communicated, evaluated, and integrated into financial decision-making. However, this consolidation has been accompanied by a narrowing of how environmental value is represented, as complex ecological processes are translated into indicators that prioritize comparability, materiality, and reporting efficiency. In contrast, green accounting offers a conceptually richer understanding of environmental value by emphasizing natural capital, ecosystem functions, and long-term system dynamics, yet it remains insufficiently embedded within the operational structures of corporate reporting. The discussion therefore centers on the implications of this misalignment and the conditions under which a more coherent integration can be achieved (Garefalakis & Dimitras, 2020; Yang & Li, 2023).

A key implication is that sustainability reporting, in its current form, does not fully capture the economic significance of environmental degradation and resource depletion. While ESG frameworks have expanded the visibility of environmental issues, they continue to reflect a perspective in which environmental value is mediated through corporate risk and performance rather than assessed as an independent dimension of economic reality. This creates a situation in which environmental impacts are acknowledged but not systematically valued, limiting the ability of reporting systems to inform decisions that are aligned with long-term ecological sustainability. The absence of natural capital valuation within ESG structures therefore represents not only a technical limitation but a conceptual constraint on how sustainability is understood and operationalized (Krasteva-Hristova et al., 2025; Wagenhofer, 2024).

The integration of green accounting principles into ESG frameworks offers a pathway for addressing this limitation by introducing a valuation logic that extends beyond indicator-based reporting. Such integration would allow sustainability reporting to move from a model focused primarily on disclosure toward one that incorporates the measurement of environmental stocks, the assessment of ecosystem services, and the recognition of ecological thresholds. However, this shift requires more than the addition of new metrics. It involves a reconfiguration of reporting practices, including the expansion of materiality concepts, the incorporation of system-level perspectives, and the development of methodologies capable of linking firm-level activities with changes in natural capital. Without such changes, attempts at integration risk remaining superficial, reinforcing existing reporting structures rather than transforming them (Lokuwaduge & De Silva, 2022; Vardopoulos, 2025).

Another important dimension of the discussion concerns the role of regulatory and institutional developments in facilitating alignment. Frameworks such as CSRD and ISSB indicate a growing recognition of the need for more comprehensive sustainability disclosures, while systems such as SEEA provide methodological foundations for environmental-economic accounting. These developments unfold within a wider reorientation of European policy toward sustainability objectives, one that extends across sectoral domains and increasingly emphasizes circularity and resource stewardship (Doukas et al., 2023, 2026). Yet, the interaction between these frameworks remains limited, reflecting a broader fragmentation within the field. The challenge is not the absence of tools, but the lack of coordination between them. Effective integration requires a bridging mechanism that can translate the valuation insights of green accounting into the standardized formats and governance structures of ESG reporting. This highlights the importance of conceptual frameworks that can operate across different levels of analysis, linking policy, accounting, and corporate practice (Costea & Hategan, 2025; Tang, 2023).

The study also underscores the importance of scale and temporality in sustainability reporting. Environmental systems operate across spatial and temporal dimensions that do not align neatly with corporate boundaries or reporting cycles. ESG frameworks, by design, simplify these dimensions in order to produce consistent and comparable disclosures. Green accounting, on the other hand, emphasizes the cumulative and long-term nature of environmental change, drawing attention to processes that may not be immediately visible within annual reporting structures. Bridging these perspectives requires an expansion of the analytical scope of ESG, allowing it to incorporate longer time horizons and system-level interactions without losing its operational clarity. This represents a significant methodological challenge, but also a necessary step if sustainability reporting is to reflect ecological realities more accurately (Parra-Domínguez et al., 2026).

In addressing the research question, the study demonstrates that the effective alignment of ESG frameworks with green accounting principles depends on recognizing their complementary roles. ESG provides the institutional infrastructure

necessary for implementation, including standardized reporting formats, regulatory support, and integration with financial systems. Green accounting contributes the conceptual and methodological depth required to capture environmental value in a more comprehensive manner. Their alignment therefore requires a synthesis in which ESG serves as the reporting interface and green accounting provides the valuation foundation. This synthesis enables natural capital to be incorporated into sustainability reporting not as a peripheral consideration, but as a central component of economic analysis.

The contribution of this study lies in clarifying the nature of the gap between ESG and green accounting and in advancing a conceptual basis for their integration. By demonstrating that current sustainability reporting frameworks remain incomplete without the incorporation of natural capital valuation, the study provides a foundation for future research aimed at developing operational models and empirical applications. At the same time, it highlights the limitations of existing approaches and the need for continued theoretical development, particularly in relation to measurement, standardization, and the reconciliation of financial and ecological perspectives (Hernandez Aros et al., 2025).

In conclusion, the evolution of sustainability reporting has reached a stage where further progress depends on moving beyond disclosure toward deeper integration of environmental value within accounting systems. ESG frameworks have established the institutional conditions for this transition, but their current structure does not fully accommodate the complexity of natural capital. Green accounting offers the necessary conceptual tools, yet its influence remains constrained by limited adoption. Bridging these approaches is therefore essential for advancing sustainability reporting in a way that reflects both economic and ecological realities. The alignment of ESG with green accounting represents not only a methodological challenge but also a broader transformation in how value is defined, measured, and governed within contemporary economic systems (Panagiotopoulos et al., 2024).

6. Future Research

The findings of this study open several avenues for future research, particularly in relation to the operationalization and empirical validation of the conceptual alignment between ESG frameworks and green accounting principles. While the present analysis establishes the theoretical basis for integrating natural capital valuation into sustainability reporting, further work is required to translate this integration into applicable models that can be adopted within corporate and policy contexts. One of the most immediate priorities lies in the development of methodologies capable of embedding natural capital valuation into ESG metrics in a manner that preserves both analytical rigor and reporting usability. This involves addressing challenges related to measurement consistency, data availability, and the standardization of valuation approaches across sectors and jurisdictions (D'Agata et al., 2024; Vardopoulos, Abeliotis, et al., 2025).

A critical direction for future research concerns empirical application. The conceptual framework proposed in this study would benefit from testing within specific industries or environmental contexts in order to evaluate its feasibility and relevance. Sector-specific analyses could provide insights into how natural capital dependencies and impacts vary across economic activities, as illustrated in domains such as the built environment and tourism (Astara et al., 2026; Vardopoulos, Koundouri, et al., 2025), allowing for the refinement of indicators and valuation techniques. Such studies would also contribute to understanding how firms can incorporate natural capital considerations into decision-making processes without compromising reporting clarity or comparability. In this regard, case-based research and pilot implementations could play a significant role in bridging the gap between theory and practice.

Further research is also needed to explore the implications of integrating natural capital valuation for financial performance, risk assessment, and corporate strategy (Cardillo & Basso, 2025; Rossi et al., 2025). While ESG frameworks are already closely linked to investment decision-making, the inclusion of green accounting principles introduces additional dimensions of value that are not fully captured by existing financial models. Investigating how these dimensions influence capital allocation, cost structures, and long-term competitiveness would provide a more comprehensive understanding of the economic relevance of sustainability. This line of inquiry is particularly important for assessing whether the integration of ESG and green accounting can move beyond disclosure and contribute to substantive changes in corporate behavior.

Another important area for future investigation relates to the role of regulatory and institutional frameworks in facilitating integration. As initiatives such as CSRD and ISSB continue to evolve, there is a need to examine how regulatory requirements can incorporate elements of natural capital valuation without imposing excessive complexity or uncertainty. Comparative studies across jurisdictions could shed light on different approaches to sustainability reporting and their

effectiveness in promoting the inclusion of environmental value within accounting systems (Costea & Hategan, 2025; Tang, 2023). Additionally, research into the interaction between corporate reporting frameworks and environmental-economic accounting systems such as the SEEA could help identify pathways for greater coherence between micro- and macro-level approaches.

The temporal and spatial dimensions of sustainability reporting also warrant further attention. Future research could focus on developing approaches that better capture long-term environmental change and system-level dynamics within the structure of ESG disclosures. This may involve the integration of scenario analysis, forward-looking indicators, and system-based metrics that extend beyond annual reporting cycles (D'Agata et al., 2023; Kempton et al., 2022). Such developments would enhance the capacity of sustainability reporting to reflect not only current performance, but also future risks and dependencies associated with natural capital.

Finally, there is a need for continued theoretical development at the intersection of accounting, economics, and environmental science. The integration of ESG and green accounting raises fundamental questions about the definition of value, the boundaries of accounting systems, and the relationship between economic activity and ecological constraints (Imbrenda et al., 2025; Zorpas et al., 2026). Addressing these questions requires interdisciplinary approaches that can reconcile different methodological traditions and epistemological perspectives. Future research in this area has the potential to contribute not only to the refinement of sustainability reporting frameworks but also to a broader rethinking of how economic systems account for and interact with the natural environment.

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