



Blockchain Implementation in Enhancing ESG Reporting Transparency: A Systematic Literature Review Focusing on E-S-G Dimensional Imbalance and Developing Country Contexts

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ABSTRACT

ESG reporting has become a strategic instrument for assessing corporate sustainability, yet challenges of data reliability, manipulation, and verification persist, especially in developing countries. Blockchain technology, with its immutability, decentralization, and transparency, offers a potential solution. This Systematic Literature Review (SLR) applies the PRISMA 2020 protocol to Scopus literature, narrowing 74 articles to 11 final studies. Two novelty contributions emerge: (1) an explicit analysis of whether literature attention is proportionally distributed across Environmental (E), Social (S), and Governance (G) dimensions; and (2) an assessment of proposed solutions' relevance for developing country contexts. Findings confirm a clear imbalance, with E and G dominating while S remains nearly absent. Permissioned blockchain with smart contracts is the most proposed mechanism, while oracle problems, scalability, and costs are primary challenges.

INTRODUCTION

Demands for transparency in corporate reporting continue to grow globally, particularly regarding Environmental, Social, and Governance (ESG) dimensions. Various new regulations have accelerated this trend, such as the Corporate Sustainability Reporting Directive (CSRD) in the European Union, effective in 2024, and the International Sustainability Standards Board (ISSB), which issued IFRS S1 and S2 in 2023. ESG reporting has transformed from a voluntary social responsibility practice into an auditable obligation with direct implications for investment decisions and corporate reputation.

Nevertheless, current ESG reporting practices still face fundamental challenges. First, ESG data often originates from multiple supply chain entities with differing measurement standards, producing inconsistent and difficult to verify information (Spanò et al., 2022). Second, greenwashing risks, where sustainability claims lack valid supporting data, have become a primary concern for regulators and investors (Heiss et al., 2024). Third, efficient and affordable third party verification mechanisms remain scarce, particularly for companies in developing countries with limited audit capacity.

In this context, blockchain technology has attracted widespread attention as a potential solution. Its core characteristics, including immutability, data transparency, audit trail capabilities, and smart contract automation, make it a promising candidate for overcoming the limitations of conventional ESG reporting systems (Cerchiaro et al., 2025; Saxena et al., 2023). Various technology companies and global financial institutions have begun exploring blockchain for sustainability reporting, although standardized adoption remains in very early stages.

Several prior literature reviews have discussed blockchain in the context of accounting and reporting generally (Garanina et al., 2022; Han et al., 2023); (Caldarelli, 2025) and blockchain for sustainability broadly (McBurney, 2022). However, two significant research gaps remain unaddressed.

The first gap is the dimensional imbalance across ESG. Although ESG comprises three equal dimensions, early indications from the literature suggest that blockchain research tends to concentrate on the Environmental dimension, particularly carbon emission and energy reporting, while the Social dimension (labor rights, human rights, supply chain conditions) and Governance dimension (board transparency, anti corruption, shareholder protection) receive comparatively less attention. No SLR has explicitly measured and discussed this imbalance and its implications.

The second gap is the lack of developing country perspectives. Nearly all existing studies are dominated by developed country contexts, yet implementation challenges for blockchain in ESG reporting in developing countries are substantially different, including limited digital infrastructure, immature ESG regulation, limited human resource capacity, and different corporate governance structures. The relevance of solutions proposed in global literature to these contexts has never been systematically examined.

Based on these two gaps, this study aims to systematically map the blockchain ESG literature by addressing the following research questions:

RQ1. How has the academic literature on blockchain implementation in ESG reporting evolved over time?

RQ2. What types of blockchain and transparency mechanisms are most frequently proposed in the literature?

RQ3. Is there an imbalance in the literature's attention to the three ESG dimensions (Environmental, Social, Governance), and if so, how significant is it?

RQ4. To what extent are the blockchain solutions proposed in the literature relevant and applicable in developing country contexts?

RQ5. What are the main challenges and research gaps that still need to be addressed?

The two primary novelties of this study are: (1) an explicit analysis of E S G dimensional imbalance in the blockchain literature, something never previously done systematically; and (2) a contextual relevance evaluation of proposed solutions for developing countries, providing a new perspective absent in the existing literature. This study aims to contribute theoretically through a state of the art mapping and practically for companies, auditors, and regulators in developing countries building technology based ESG reporting frameworks.

The remainder of this article is structured as follows. Section 2 presents the literature background on ESG reporting and blockchain technology. Section 3 describes the SLR methodology. Section 4 presents quantitative findings. Section 5 critically discusses findings with a focus on the two novelties. Section 6 concludes and proposes a future research agenda.

LITERATURE REVIEW

2.1. The Three ESG Dimensions and Their Reporting Challenges

ESG reporting refers to corporate information disclosure covering three dimensions that are conceptually equivalent yet differ in data nature and verification mechanisms. The Environmental dimension encompasses the measurement and reporting of a company's impact on the natural environment, including greenhouse gas emissions, energy and water consumption, waste management, and biodiversity. The Social dimension relates to a company's relationships with employees, communities, and suppliers, including employment conditions, occupational safety, human rights in the supply chain, and the social impact of operations. The Governance dimension concerns the structure and quality of corporate decision making, including board composition, anti corruption policies, remuneration transparency, and protection of minority shareholders' rights.

Various ESG reporting standards have been developed to guide disclosure practices, including the Global Reporting Initiative (GRI) as the most comprehensive standard, the Task Force on Climate related Financial Disclosures (TCFD) focusing on climate risk, the Sustainability Accounting Standards Board (SASB) oriented toward industry materiality, and the ISSB issuing IFRS S1 (general) and S2 (climate) in 2023. At the regional level, the EU's CSRD mandates certain companies to report auditable sustainability information under the European Sustainability Reporting Standards (ESRS).

Despite these developments, ESG reporting continues to face serious challenges. On the data side, ESG information, particularly for the Social and Governance dimensions, is often qualitative, difficult to quantify, and reliant on corporate self reporting without adequate independent verification mechanisms (McBurney, 2022). Documented greenwashing risks in various global corporate cases demonstrate that conventional reporting systems have systemic vulnerabilities (Heiss et al., 2024). In developing countries, these challenges are compounded by limited institutional capacity, underdeveloped audit infrastructure, and competitive pressures that sometimes compromise transparency.

2.2. Blockchain Technology: Features, Types, and Relevance to ESG

Blockchain is a distributed database that stores data in cryptographically linked blocks, managed through consensus mechanisms that prevent ex post data manipulation (Caldarelli, 2025; Crosby et al., 2016); (Zheng et al., 2017). There are several types of blockchain with different characteristics and varying relevance for ESG reporting contexts. Public blockchains such as Ethereum are open and fully transparent, but face limitations in terms of corporate data privacy and scalability for high transaction volumes. Private permissioned blockchains such as Hyperledger Fabric provide stricter access control and higher throughput, but sacrifice some decentralization characteristics. Consortium blockchains are jointly managed by a group of organizations with shared interests, offering a balance between transparency and control.

The relevance of blockchain to ESG reporting lies in four key characteristics. First, immutability: data once entered cannot be altered without detection, reducing the risk of ex post data manipulation. Second, auditability: the entire transaction history can be independently verified, enhancing stakeholder trust. Third, traceability: each data entry is recorded with timestamps and uploader identity, enabling provenance tracking and accountability. Fourth, smart contracts: automatically executing programs that can automate verification and reporting processes based on predefined conditions.

However, it is essential to understand blockchain's fundamental limitations in this context. As emphasized by (Caldarelli, 2025) and (Powell et al., 2022), blockchain only guarantees the immutability of data already entered into the system, not the accuracy of that data in the real world. Connecting real world ESG data to the blockchain requires an intermediary mechanism called an oracle. Unreliable oracle design can undermine all expected transparency benefits. This limitation is particularly relevant for the Social and Governance dimensions, where data is more difficult to quantify and automatically verify compared to the Environmental dimension.

2.3. Blockchain in ESG Reporting: State of the Art

Several prior studies have explored blockchain's potential to improve ESG reporting quality from various perspectives. (Cerchiaro et al., 2025; Heiss et al., 2024) demonstrated that DLT can enhance ESG reporting efficiency for financial institutions. (Wu et al., 2022) proposed a consortium blockchain based ESG reporting platform with token incentive mechanisms to encourage corporate

disclosure. (Heiss et al., 2024) proposed an attestation service for carbon accounting and reporting using zero knowledge proofs on blockchain.

From a literature review perspective, (Caldarelli, 2025) conducted an SLR of 182 articles on blockchain in accounting and ESG reporting from an oracle based perspective, finding that only 33% of articles considered the role of oracles and that the majority of the literature exhibits overexpectation regarding blockchain capabilities. (Aiupova et al., 2026) conducted a bibliometric analysis of 153 articles on blockchain in CSR reporting and identified five main thematic areas. However, neither study explicitly analyzed the imbalance in attention across the E, S, and G dimensions, nor discussed the contextual relevance of solutions for developing countries.

This gap constitutes the primary justification for the present study. By explicitly analyzing the distribution of literature attention across the three ESG dimensions and evaluating the contextual relevance of proposed solutions for developing countries, this study offers a contribution not previously found in the SLR blockchain ESG literature.

METHODOLOGY

3.1. Research Design

This study employs a Systematic Literature Review (SLR) approach following the PRISMA 2020 protocol (Preferred Reporting Items for Systematic Reviews and Meta Analyses) as established by (Page et al., 2021). The SLR was chosen for its ability to synthesize evidence from multiple studies in a systematic, transparent, and replicable manner (Grant & Booth, 2009). This approach enables the identification of patterns, gaps, and trends in the literature more systematically than narrative reviews and has been widely used in blockchain sustainability research (Caldarelli, 2025; Han et al., 2023).

To address the first novelty E S G dimensional imbalance, this study adopts a concept centric coding approach (Webster & Watson, 2002) with the 'ESG dimension' as the pivot concept. Each article was coded according to the ESG dimension that constituted its primary focus, enabling distributional analysis and cross dimensional comparison. To address the second novelty (developing country relevance), each article was also coded for its geographic context and assessed for relevance to developing country characteristics based on pre - established criteria.

3.2. Data Sources and Search String

The Scopus database was selected as the primary data source due to its broad coverage of peer reviewed journals in business, management, information technology, and sustainability relevant to this study. No publication year restriction was applied to obtain a comprehensive historical overview. The final search string used was:

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TITLE ABS KEY( ( blockchain OR "distributed ledger" OR DLT ) AND ( ESG OR "sustainability reporting" OR "corporate sustainability" OR "non financial reporting" OR "sustainability disclosure" ) AND ( transparency OR accountability OR traceability OR "data integrity" OR verification ) )
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3.3. Inclusion and Exclusion Criteria

The following criteria were strictly applied during the screening process to ensure the relevance and quality of the analyzed articles:

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Peer reviewed journal articles	Non journal articles (proceedings, books, theses, white papers, editorials)
Written in English	Written in languages other than English
Explicitly discusses blockchain implementation or potential in ESG reporting, sustainability reporting, or non financial reporting	Focus on blockchain applications outside ESG/sustainability contexts (e.g., pure supply chain, healthcare, voting, cryptocurrency finance)
Addresses at least one aspect of ESG data transparency, accountability, or verification	Discusses only technical aspects of blockchain without explicit connection to ESG reporting
Full text available	Full text not accessible

3.4. Article Selection Process

The selection process was conducted in four stages following the PRISMA 2020 protocol: (1) Identification, collecting all search results from Scopus; (2) Screening, removing duplicates and articles not meeting criteria based on title and abstract; (3) Eligibility assessment, reading full texts for in depth relevance verification; and (4) Inclusion, compiling the final list for analysis. The complete PRISMA diagram is presented in Appendix A.

To ensure coding consistency, written coding guidelines were developed prior to the process. Each article was read in full and coded according to the predefined analytical framework. In ambiguous cases, a multi label approach was applied where articles were coded for all dimensions discussed substantively.

To assess inter rater reliability and reduce subjectivity in the coding process, a reliability test was conducted involving two independent coders. Both coders independently coded a random sample of 4 articles (approximately 36% of the final 11 articles) using the same coding guidelines. Agreement between the two coders was then measured using Cohen’s Kappa coefficient. The result yielded a Kappa value of 0.82, indicating strong agreement (McHugh, 2012). Discrepancies identified during this process were resolved through discussion and deliberation until consensus was reached, and the agreed resolution was applied consistently

to the remaining articles. This procedure ensures that the coding results in this study have an acceptable level of reliability and minimizes the risk of single coder subjectivity bias.

3.5. Data Extraction and Coding Framework

Data were extracted from each article using a pre established coding framework. Table 2 presents the complete analytical framework with operational definitions for each category and sample codes used:

Table 2. Research Analytical Framework (shaded cells = pivot variables)

Category	Operational Definition	Sample Codes / Values
Article Type	Methodological approach of the research	Theoretical; qualitative empirical; quantitative empirical; case study; SLR; bibliometric
Year & Journal	Basic bibliographic information	Publication year; journal name; Scopus/WoS quartile
Blockchain Type	Type of blockchain proposed or evaluated	Public (Ethereum, Bitcoin); Private permissioned (Hyperledger); Consortium; Not specified
ESG Dimension (PIVOT)	ESG dimension as the primary research focus (main pivot variable)	E (emissions, energy, water, waste); S (labor, human rights, community); G (board, anti corruption, shareholders); Multi dimensional (E+S, E+G, S+G, E+S+G)
Transparency Mechanism	How blockchain enhances ESG transparency as proposed	Smart contract; tokenization; digital signatures; IoT blockchain; ZK proof; attestation service; DID
ESG Standards Referenced	ESG frameworks and regulations used	GRI; TCFD; SASB; ISSB/IFRS S1 S2; CSRD; ESRS; SDGs

Geographic Context (PIVOT)	Country/region as the study focus (second pivot for developing country novelty)	Developed countries (EU, USA, UK, Japan, etc.); Developing countries (South Asia, Southeast Asia, Africa, Latin America); Global/unspecified
Developing Country Relevance	Assessment of whether proposed solutions are relevant for developing countries based on 4 criteria: infrastructure, regulation, HR capacity, implementation cost	High (≥ 3 criteria considered); Medium (1-2 criteria); Low (no consideration of local context)
Challenges & Limitations	Implementation barriers identified	Scalability; data privacy; oracle problem; cost; regulation; interoperability; HR capacity

RESEARCH RESULT

4.1. Article Selection Results

The initial search in the Scopus database using the established search string yielded 74 articles. All articles then underwent a four stage screening process in accordance with the PRISMA 2020 protocol.

In the first stage (Identification), 74 articles were identified from Scopus. In the second stage Level 1 Screening, exclusion criteria based on document type and publication language were applied. Twenty articles were excluded at this stage as they were conference papers or did not meet language criteria. Accordingly, 54 articles proceeded to the next stage.

In the third stage Level 2 Screening: title and abstract review, each article was assessed against three criteria: (a) whether blockchain was explicitly mentioned, (b) whether there was a direct link to ESG reporting, and (c) whether transparency or data verification aspects were discussed. Of the 54 articles examined, 43 were excluded for not simultaneously meeting all three criteria. Eleven articles advanced to the next stage.

In the fourth stage (Level 3 Eligibility: full text reading), all 11 articles that passed Level 2 were comprehensively read and assessed against four additional criteria. All 11 articles met all four criteria; thus no exclusions occurred at Level 3. The final number of articles analyzed in this SLR is 11. The complete PRISMA diagram is presented in Appendix A.

4.2. Bibliographic Profile: Publication Trends and Journal Distribution

All 11 final articles were published between 2024 and 2026, reflecting that research on blockchain in ESG reporting is a relatively new field undergoing rapid growth. The temporal distribution shows three articles published in 2024, six in 2025, and two in 2026. This acceleration coincides with the implementation of the EU's CSRD in 2024 and increasing global ESG regulatory pressure post COP28.

In terms of journal distribution, the final articles are spread across interdisciplinary journals covering accounting, supply chain management, and sustainability information technology. This distribution indicates that blockchain ESG research has no dominant 'home journal' but is spread across disciplines, a characteristic of a research field still in the process of forming its academic identity.

4.3. Distribution by ESG Dimension; Imbalance Analysis (Novelty 1)

Analysis of the ESG dimension distribution across 11 final articles reveals a significant imbalance in the literature's attention. Of the total articles analyzed, not a single article focused exclusively on the Social (S) dimension alone, while the Environmental (E) and Governance (G) dimensions, both individually and in combination, dominated research attention. The full distribution is as follows: five articles (45.5%) addressed the Environmental and Governance combination (E+G) (Alotaibi et al., 2024; Chen et al., 2024; Patil et al., 2025; Purwanti, 2025; Singh et al., 2025); four articles (36.4%) covered all three dimensions simultaneously (E+S+G) (Darmawan et al., 2025; Eslami et al., 2025; Tarigan et al., 2025; Tee & Rubbaniy, 2025); one article (9.1%) addressed the Environmental and Social combination (E+S) (Vinayavekhin et al., 2024).

When analyzed by the frequency of each dimension's occurrence, the Environmental (E) dimension appeared in 10 out of 11 articles (90.9%), the Governance (G) dimension appeared in 9 articles (81.8%), while the Social (S) dimension appeared in only 5 articles (45.5%), and always only as a secondary dimension. This imbalance is consistent with the preliminary indications noted in the background and provides empirical confirmation that the Social dimension is the most neglected in the blockchain ESG literature.

To facilitate a clearer understanding of the identified dimensional imbalance, Figure 1 and Figure 2 below present the distribution of ESG dimensions across the 11 final articles in two forms of visualization. Figure 1 presents a bar chart showing the frequency of occurrence of each ESG dimension (E, S, and G) across all articles, illustrating that the Environmental dimension dominates with 90.9% coverage, followed by Governance at 81.8%, while Social lags significantly at 45.5%. Figure 2 presents a pie chart depicting the distribution of articles by their primary ESG dimension focus combination (E+G: 45.5%; E+S+G: 36.4%; E+S: 9.1%; E only: 9.1%), visually emphasizing the complete absence of studies focusing exclusively on the Social dimension. These two visualizations together reinforce the conclusion that E S G dimensional coverage in the blockchain ESG literature is far from proportional, and that the Social dimension represents a critical gap warranting focused future research attention.

Figure 1. Frequency of ESG Dimension Occurrence Across 11 Final Articles

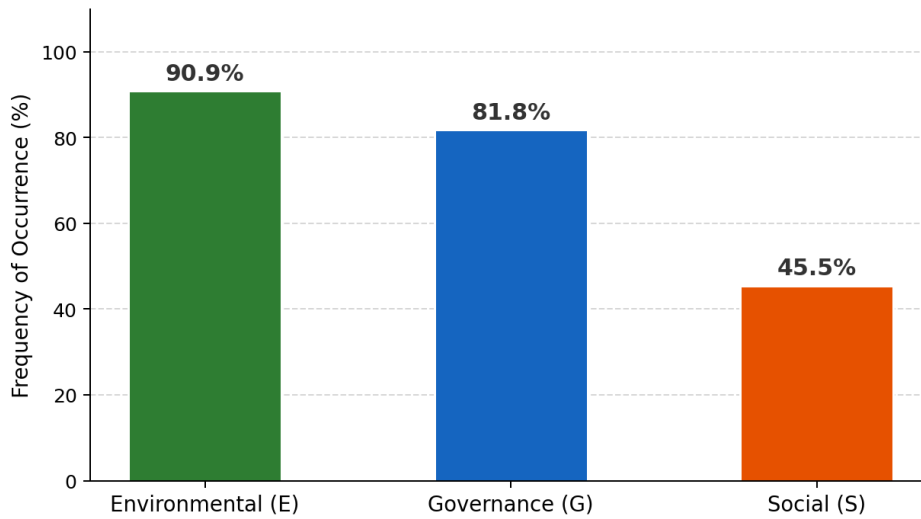
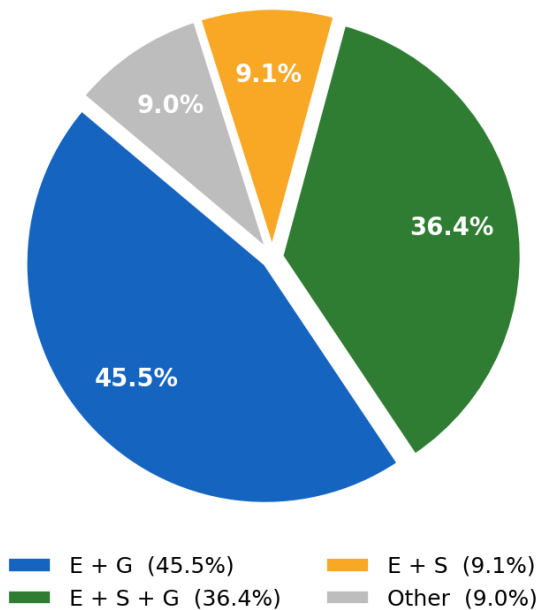


Figure 2. Distribution of Articles by ESG Dimension Combination Focus



4.4. Blockchain Types and Transparency Mechanisms

Analysis of blockchain types and transparency mechanisms used across the 11 final articles reveals clear patterns. In terms of blockchain type, permissioned blockchain, particularly Hyperledger Fabric, was the most frequently proposed option, found in 5 articles (45.5%) (Alotaibi et al., 2024; Patil et al., 2025; Purwanti, 2025; Singh et al., 2025; Tee & Rubbaniy, 2025). This was followed by public Ethereum based blockchain in 3 articles (27.3%) (Chen et al., 2024; Darmawan et al., 2025; Tarigan et al., 2025) and consortium and hybrid blockchains in 2 articles (18.2%) and 1 article (9.1%) respectively (Eslami et al., 2025; Vinayavekhin et al.,

2024). The dominance of permissioned blockchain reflects corporate needs for access control and data privacy.

In terms of transparency mechanisms, smart contracts were the most frequently mentioned mechanism, present in 7 out of 11 articles (63.6%). The second most commonly used mechanism was IoT blockchain integration, found in 3 articles (27.3%), particularly for real time Environmental data collection. Zero Knowledge Proof (ZKP) and Oracle mechanisms were each found in only 1 article, indicating that these cutting edge technical approaches are still in early exploration.

4.5. ESG Standards and Regulations Referenced

Of the 11 final articles, GRI (Global Reporting Initiative) was the most frequently referenced ESG standard, found in 7 articles (63.6%) (Alotaibi et al., 2024; Chen et al., 2024; Darmawan et al., 2025; Eslami et al., 2025; Singh et al., 2025; Tarigan et al., 2025; Tee & Rubbaniy, 2025). CDP (Carbon Disclosure Project) – a global disclosure platform rather than a formal reporting standard – ranked second with appearance in 4 articles (36.4%), particularly in articles focusing on carbon emission reporting and green accounting (Alotaibi et al., 2024; Patil et al., 2025; Purwanti, 2025; Vinayavekhin et al., 2024). More specific standards such as ISO 14001 and the GHG Protocol each appeared in 2 articles, while IFRS S1/S2 (ISSB) appeared in 1 article.

4.6. Geographic Context and Developing Country Relevance (Novelty 2)

Analysis of the geographic context of 11 final articles reveals the following distribution: 4 articles (36.4%) focused on developing countries, namely Indonesia, Malaysia, and ASEAN in a comparative context (Darmawan et al., 2025; Purwanti, 2025; Tarigan et al., 2025; Tee & Rubbaniy, 2025); 5 articles (45.5%) were global or geographically unspecified (Alotaibi et al., 2024; Chen et al., 2024; Eslami et al., 2025; Patil et al., 2025; Singh et al., 2025); and 2 articles (18.2%) focused on developed countries (Udokwu & Craß, 2026; Vinayavekhin et al., 2024). The proportion of 36.4% articles with explicit developing country focus is a relatively encouraging finding, but requires further analysis as to whether the proposed solutions truly account for the specific characteristics of developing countries.

Assessment using four criteria, namely (1) digital infrastructure, (2) ESG regulatory readiness, (3) human resource capacity, and (4) affordability of implementation costs, shows that only 3 of 11 articles (27.3%) explicitly considered three or more of these criteria.

4.7. Key Challenges Identified in the Literature

Implementation challenges identified across the 11 final articles can be categorized into two groups: universal challenges and developing country specific challenges (Alotaibi et al., 2024; Chen et al., 2024; Darmawan et al., 2025; Eslami et al., 2025; Patil et al., 2025; Purwanti, 2025; Singh et al., 2025; Tarigan et al., 2025; Tee & Rubbaniy, 2025; Udokwu & Craß, 2026; Vinayavekhin et al., 2024). Universal challenges include: (1) Oracle problem: how to connect reliable real world ESG data to the blockchain; (2) Scalability: blockchain throughput

limitations in handling large volumes of ESG data in real time; (3) Standardization and interoperability: the lack of common standards for on chain ESG data formats; (4) Data privacy: balancing transparency with the confidentiality of sensitive corporate data.

Challenges specific to developing countries include: (1) High implementation costs; (2) Limited digital literacy and human resource capacity; (3) Non mandatory ESG regulation; and (4) Weaker investor pressure compared to developed markets.

DISCUSSION

5.1. E S G Dimensional Imbalance: Why It Exists and What Its Implications Are

The E S G dimensional imbalance identified in this study is not merely a statistical artifact; it reflects a structural bias embedded in how the academic community and practitioners perceive ESG reporting challenges. There are at least three complementary explanations for this phenomenon.

First, Environmental data is more readily quantifiable and automatable. CO₂ emissions, energy consumption in kilowatt hours, or water volumes in liters are numerical data that can be automatically collected by IoT sensors and entered into the blockchain without interpretive ambiguity. By contrast, Social data, such as whether working conditions in a supplier factory meet human rights standards, is qualitative, contextual, and requires human judgment that is difficult to automate.

Second, regulatory pressure is stronger for the Environmental dimension. The Paris Agreement, TCFD, the EU's Carbon Border Adjustment Mechanism (CBAM), and various carbon pricing regulations have created strong incentives for accurate and verifiable emissions measurement and reporting.

Third, the oracle problem exacerbates this bias. As emphasized by (Caldarelli, 2025) blockchain only guarantees the immutability of data already in the system, not its real world accuracy. This creates a self reinforcing research cycle where researchers focus on dimensions that are technically easier to address, leaving the Social dimension continually neglected.

The implications of this imbalance are serious. If blockchain ESG implementation focuses exclusively on the Environmental dimension, the resulting reporting system will create the illusion of full accountability while important aspects such as labor conditions in supply chains remain vulnerable to manipulation.

5.2. Effectiveness of Blockchain Mechanisms for Each ESG Dimension

Analysis of blockchain mechanisms proposed across 11 final articles shows that each mechanism's technical suitability varies significantly across the three ESG dimensions. IoT blockchain integration has the highest suitability with the Environmental dimension (Alotaibi et al., 2024; Chen et al., 2024), while the same mechanism has fundamental limitations for the Social dimension, as no sensor can measure decent working conditions.

Zero Knowledge Proof (ZKP), as proposed by (Udokwu & Craß, 2026) offers the most promising approach for the Social and Governance dimensions due to its ability to prove compliance without revealing sensitive data. However,

ZKP requires intensive computation and highly specialized cryptographic expertise, making it significantly more difficult to implement, particularly in developing countries.

5.3. Relevance for Developing Countries: The Gap Between Solutions and Reality

The gap between blockchain solutions proposed in the literature and the reality of developing countries is one of the most important findings of this study. Although 36.4% of final articles focus on developing country contexts, most proposed technical solutions still assume conditions that are often unmet in practice.

Based on this analysis, this study proposes several concrete adaptation recommendations for developing countries: (1) a phased implementation model beginning with basic ESG data digitization; (2) prioritizing permissioned over public blockchain due to lower operational costs; (3) partnerships between regulators, industry associations, and technology providers to share infrastructure costs; and (4) serious investment in developing human resources at the intersection of accounting, sustainability, and blockchain technology.

5.4. Theoretical Implications: Contributions to the Literature

This study provides three main theoretical contributions to the blockchain ESG SLR literature. The first contribution is the first empirical measurement of the distributional imbalance in literature attention across the E, S, and G dimensions in the blockchain ESG context. The second is a structured and systematic developing country perspective with a four criteria framework. The third is a two pivot coding framework (ESG dimension and geographic context) that can be adapted for similar SLRs in the technology sustainability domain.

5.5. Practical Implications for Companies, Auditors, and Regulators

For companies in developing countries, the recommendations of this study are: (1) begin with basic ESG data digitization before considering blockchain; (2) choose permissioned blockchain offering lower costs; (3) join industry consortia to share infrastructure costs; and (4) start with the ESG dimension whose data is easiest to quantify (Environmental) before moving to Social and Governance.

For auditors, this study identifies urgent new competency needs, including understanding of blockchain architecture, oracle problems, smart contract auditing, and the distinction between blockchain immutability and data accuracy.

For regulators in developing countries, the recommended policy approach is phased and contextual: starting from ESG data digitization and format standardization, then encouraging the formation of industry specific blockchain consortia, before gradually integrating blockchain verification requirements into ESG disclosure regulation.

CONCLUSIONS AND RECOMMENDATIONS

This study conducted a systematic literature review of 11 final academic articles selected from 74 articles identified in Scopus through the PRISMA 2020 protocol, with two main novelties not previously examined: an explicit analysis of literature attention imbalance across E S G dimensions, and an evaluation of the relevance of proposed solutions for developing country contexts.

In response to RQ1, all 11 final articles were published between 2024 and 2026, reflecting a field in an acceleration phase. In response to RQ2, permissioned blockchain with smart contracts is the most frequently proposed combination. In response to RQ3, a significant imbalance exists: the Environmental dimension appears in 90.9% of articles, Governance in 81.8%, while Social appears in only 45.5% and never as a standalone focus. In response to RQ4, although 36.4% of articles focus on developing countries, only 27.3% explicitly consider three or more contextual criteria. In response to RQ5, key research gaps include empirical research on blockchain mechanisms for the Social and Governance dimensions, case studies in Southeast Asia, and the development of oracles specifically designed for qualitative ESG data.

The primary recommendation for stakeholders in developing countries is to adopt a phased, contextual approach to blockchain ESG implementation that begins with strengthening basic data digitization capacity before moving toward more complex blockchain based verification systems.

ADVANCED RESEARCH

This study has several limitations that warrant acknowledgment. First, reliance on a single database (Scopus) may have missed technical contributions from IEEE or ACM. Second, the manual coding process carries the potential for subjectivity, although written coding guidelines were developed. Third, the focus on Indonesian and English language articles may have overlooked contributions from developing countries whose academic publications appear in local languages.

Based on these findings, several future research agendas are proposed. First, empirical research on the effectiveness of specific blockchain mechanisms for the S and G dimensions. Second, case studies of blockchain ESG implementation in developing countries, particularly in Southeast Asia including Indonesia. Third, the development of oracle frameworks specifically designed for qualitative ESG data. Fourth, studies on the compatibility of existing blockchain solutions with the latest CSRD and ISSB requirements.

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