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Sustainability Reporting in Extractive Industries: A Systematic Literature Review and Research Agenda

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ABSTRACT

This study provides a systematic and integrative review of ESG and sustainability reporting in extractive industries, aiming to assess the current state of the literature and identify key theoretical, methodological, and contextual gaps. Given the growing importance of extractive sectors in supporting global sustainability transitions, understanding the role of ESG reporting as a governance mechanism is increasingly critical. The review adopts a domain-based approach combining bibliometric mapping, thematic analysis, and content-based classification. A dataset of 106 peer-reviewed articles (2000–2025) was analysed using Bibliometrix and VOSviewer, alongside a structured coding framework based on theoretical, contextual, and methodological dimensions. The findings reveal a rapidly expanding but still fragmented research field. From a theoretical perspective, the literature remains predominantly anchored in traditional frameworks such as stakeholder and legitimacy theories, while a fully integrated ESG and governance-oriented perspective is still emerging. Methodologically, the field shows a prevalence of quantitative approaches, although these are predominantly applied in descriptive and exploratory ways. The results also highlight a strong imbalance across ESG dimensions, with environmental issues receiving significantly greater attention than social and governance aspects. In addition, the literature is geographically concentrated in developed economies, with emerging and resource-intensive regions underrepresented. A central contribution of this study lies in identifying a structural misalignment between academic research and ongoing regulatory developments. While the literature continues to emphasise voluntary disclosure practices, the global reporting landscape is increasingly shaped by mandatory and standardised frameworks. This transition redefines sustainability reporting from a legitimacy-driven communication tool to a formalised governance mechanism, although its effectiveness in driving substantive sustainability performance remains uncertain. Overall, this study aims to contribute to the literature by providing a comprehensive mapping of ESG reporting research in extractive industries and by advancing an interpretative framework that highlights its evolving role within sustainability transitions. The findings offer relevant insights for scholars, policymakers, and practitioners, and outline key directions for future research aimed at strengthening the theoretical and empirical foundations of the field.

1 | Introduction

In recent years, sustainability has become a central concern across industries, driven by increasing awareness of climate

change, resource scarcity, and the need for more responsible corporate practices, and particularly in extractive sectors, where environmental and social impacts are especially significant (Fonseca et al. 2014; Jenkins and Yakovleva 2006). Within

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this evolving landscape, sustainability reporting and Environmental, Social, and Governance (ESG) disclosure have emerged as key mechanisms through which companies communicate non-financial performance and respond to growing stakeholder expectations (Purvis et al. 2019).

The adoption of structured sustainability reporting frameworks has expanded significantly in recent years, reflecting the growing institutionalisation of non-financial disclosure practices and the increasing global uptake of standards such as those developed by the GRI (Paridhi and Arora 2023).

The extractive sector represents a particularly critical context for sustainability reporting (Fonseca et al. 2014). While it plays a strategic role in supplying the raw materials required for economic development and the global energy transition, it is also associated with significant environmental impacts and social conflicts (Mancini and Sala 2018). As a result, transparency and accountability have become essential for maintaining legitimacy and securing a social licence to operate (Jenkins and Yakovleva 2006; Owen and Kemp 2013).

Over time, extractive companies have progressively developed more structured sustainability reporting practices, moving from informal disclosure toward standardised frameworks. Early contributions highlighted the emergence of Corporate Social Responsibility (CSR) reporting in mining (Jenkins 2004; KPMG 2011), while subsequent studies examined the increasing institutionalization of sustainability reporting practices and their integration into corporate strategies (de Villiers et al. 2014; Lodhia and Hess 2014). This evolution reflects a gradual transition from fragmented disclosure practices towards more formalised sustainability reporting in the mining sector (Perez and Sanchez 2009). More recent research has further explored the role of sustainability disclosure in shaping corporate accountability, governance, and stakeholder engagement within extractive industries (Böhling et al. 2019; Chipangamate et al. 2023; Gray et al. 2019).

Despite this growing body of literature, sustainability reporting research in extractive industries remains fragmented and heterogeneous. Contributions are dispersed across multiple disciplines, including accounting, business ethics, and environmental management, reflecting the interdisciplinary nature of the field (Barkemeyer et al. 2015). Existing studies address a wide range of issues, including environmental disclosure, stakeholder engagement, and governance practices (Dong et al. 2014), yet these research streams often develop in parallel, with limited integration across theoretical and empirical approaches (Mahmood and Orazalin 2017).

Bibliometric evidence confirms this fragmentation while also highlighting a clear conceptual core of the field. Sustainability reporting emerges as the central research theme, closely connected to CSR and sustainable development, while theoretical perspectives such as stakeholder theory and legitimacy theory provide the main interpretative lenses. At the same time, emerging topics such as greenwashing and stakeholder engagement indicate a shift toward more critical and governance-oriented perspectives (Alves et al. 2021; Talbot and Boiral 2018).

Several important gaps can be identified within this evolving literature. First, there is limited clarity regarding how sustainability and non-financial reporting are conceptually framed in extractive industries, with studies adopting different theoretical perspectives and definitions (Fuisz-Kehrbach 2015; Perez and Sanchez 2009). Second, the literature employs a wide range of methodological approaches, yet lacks a systematic understanding of dominant research designs (Gilsbach et al. 2022). Third, ESG dimensions are often analysed separately, with limited attention to their integration within reporting practices (Bini et al. 2018; Ivic et al. 2021; Mudd 2008). Finally, while sustainability reporting has historically been largely voluntary, the recent shift toward more formalised and mandatory disclosure frameworks introduces new dynamics that remain underexplored (Amoako et al. 2017).

In rapidly expanding and conceptually fragmented research domains, systematic literature reviews combined with bibliometric techniques provide a valuable approach to synthesising existing knowledge and identifying future research directions (Vrontis and Christofi 2021). Such approaches enable the mapping of the intellectual, conceptual, and thematic structure of a field, offering a comprehensive understanding of its evolution.

To address these gaps, this study conducts a systematic literature review of sustainability and ESG reporting in extractive industries, combining bibliometric analysis with thematic and structured content analysis (Furrer et al. 2020; Hulland and Houston 2020). This integrated approach enables not only the mapping of the intellectual and conceptual structure of the field, but also a deeper understanding of its main research streams, their evolution, and the characteristics of existing studies. The analysis is based on a dataset of 106 peer-reviewed journal articles retrieved from Scopus and refined through a rigorous screening and snowballing process (Gierczyk et al. 2023).

The study is guided by the following research questions:

- RQ1.** How is sustainability and non-financial reporting conceptualised in academic research on extractive and mining industries?
- RQ2.** What research methods and analytical approaches are used to study sustainability and ESG reporting in extractive industries?
- RQ3.** Which ESG dimensions and disclosure themes are most frequently addressed in the extractive industry reporting literature?
- RQ4.** What evidence exists on the effects of mandatory and voluntary sustainability reporting frameworks on extractive firms' practices?

By addressing these questions, this study intends to contribute to the literature in several ways. First, it offers a structured synthesis of ESG reporting research in extractive industries through the integration of bibliometric, thematic, and content-based analyses, in line with established guidelines for systematic literature reviews (Donthu et al. 2021). Second, the

study identifies a structural transition in the role of sustainability reporting within extractive industries, highlighting a misalignment between the academic focus on voluntary and legitimacy-driven disclosure and the ongoing shift toward mandatory and governance-oriented reporting frameworks. In doing so, the paper conceptualises ESG reporting as a transitional governance mechanism, evolving from a legitimacy-driven communication tool toward a more formalised and institutionalised component of corporate governance systems. Furthermore, the integration of bibliometric, thematic, and content-based analyses enables linking quantitative mapping techniques with qualitative interpretation, offering a more comprehensive understanding of the field (Klarin 2024). The study also provides insights relevant for policymakers and practitioners involved in the design and implementation of sustainability reporting frameworks in resource-intensive sectors.

The remainder of the paper is structured as follows. Section 2 presents the theoretical background of sustainability and ESG reporting in extractive industries. Section 3 outlines the research methodology. Section 4 reports the results of the bibliometric and descriptive analyses. Section 5 discusses the findings. Section 6 concludes.

2 | Theoretical Background

Sustainability reporting in extractive industries has evolved as a multifaceted field of inquiry, positioned at the intersection of environmental management, corporate governance, and social accountability. The literature included in this review highlights how non-financial disclosure plays a strategic role in sectors characterised by significant environmental impacts and complex stakeholder relationships (Alves et al. 2021; Fonseca 2010; Fonseca et al. 2014; Howe et al. 2025; Jenkins 2004; Jenkins and Yakovleva 2006). Across the dataset, sustainability reporting emerges not merely as a communication tool, but as a mechanism through which firms seek to manage external expectations and align with broader sustainability transitions (Muñoz-Lagos et al. 2025).

A dominant interpretative lens underpinning this body of research is legitimacy theory, which conceptualises sustainability reporting as a response to societal pressures and expectations. Within extractive industries, firms operate under intense scrutiny due to their environmental footprint and social implications, leading to a strong reliance on disclosure practices aimed at maintaining or repairing legitimacy (Talbot and Boiral 2018). Several studies interpret reporting practices as symbolic or strategic tools used to address reputational risks and secure continued access to resources and operational approvals, highlighting the dual role of disclosure as both substantive and impression-management practice (Boiral and Henri 2017; Centorrino et al. 2025).

Alongside legitimacy theory (Dube and Maroun 2017), stakeholder theory (Ranängen 2017) represents a second foundational framework within the literature. Extractive operations typically involve a wide range of stakeholders, including local communities, regulators, investors, and civil society organisations, and are therefore deeply dependent on the maintenance of a social licence to operate (Owen and Kemp 2013). The reviewed studies

emphasise how sustainability reporting is shaped by the need to address heterogeneous stakeholder demands, often resulting in differentiated disclosure strategies (Jenkins and Yakovleva 2006). In this context, reporting becomes a means of engagement and negotiation, enabling firms to manage conflicts, enhance transparency, and support the attainment of a social licence to operate (Sciulli and Adhariani 2022).

A further relevant perspective is provided by institutional theory (Oliveira and Silva 2026), which explains the diffusion and standardisation of sustainability reporting practices through regulatory pressures, industry norms, and international frameworks. The increasing adoption of structured reporting practices is interpreted as a process of institutionalisation driven by governance mechanisms and regulatory interventions (de Villiers et al. 2014; Dong et al. 2014; Lodhia and Hess 2014). Within the dataset, particular attention is given to the role of regulation in shaping disclosure practices, especially in relation to environmental accountability and risk management in mining contexts (Crous and Marais 2025; Moran et al. 2014; Mudd 2008; Northey et al. 2019).

These theoretical perspectives converge in framing sustainability reporting as a dynamic and context-dependent practice, influenced by both external pressures and internal strategic considerations. Importantly, the literature reveals a persistent tension between voluntary and mandatory reporting regimes, which constitutes a key analytical dimension of this review. While voluntary disclosure has historically dominated the field, recent regulatory developments are progressively reshaping the landscape, raising questions about the effectiveness, comparability, and credibility of sustainability reporting practices (Adler et al. 2017; Crous and Marais 2025; Ivic et al. 2021; Lee 2017; Leong et al. 2014; Mahmood and Orazalin 2017). Some studies highlight improvements in transparency and governance, while others point to risks of symbolic compliance and greenwashing (Alves et al. 2021; Liu and Agusdinata 2020; Talbot and Boiral 2018; Zharfpeykan 2021).

Overall, the theoretical foundations identified in the dataset reveal a field characterised by conceptual plurality but anchored in a relatively coherent core of interpretative frameworks. At the same time, the coexistence of multiple theoretical perspectives reflects the inherent complexity of sustainability reporting in extractive industries, where environmental, social, and governance dimensions are deeply intertwined. This conceptual diversity, while enriching the field, also contributes to its fragmentation, underscoring the need for integrative approaches capable of bridging disciplinary boundaries and advancing a more holistic understanding of reporting practices.

Taken together, these perspectives suggest that sustainability reporting in extractive industries cannot be fully understood through traditional CSR-based lenses alone. While legitimacy, stakeholder, and institutional theories explain the drivers of disclosure, they provide only a partial account of its evolving function. In particular, the increasing diffusion of mandatory and standardised reporting frameworks points to a shift from disclosure as a legitimacy-seeking practice toward reporting as a governance mechanism embedded within regulatory and organisational systems. This transition remains only partially conceptualised in the existing literature and represents a key interpretative gap addressed in this review.

3 | Methodology

This study adopts a systematic literature review (SLR) to investigate the evolution of environmental, social, and governance (ESG) and sustainability reporting research within extractive industries. Systematic literature reviews are widely recognised as a rigorous approach for synthesising fragmented bodies of knowledge, allowing researchers to structure existing evidence, identify dominant research streams, and highlight emerging research gaps (Paul and Criado 2020). Compared with traditional narrative reviews, the SLR methodology enhances transparency and replicability by applying explicit procedures for literature identification, selection, and analysis.

To ensure methodological rigour, this study follows the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) framework proposed by (Paul et al. 2021). This protocol structures the review process into three main stages: assembling, arranging, and assessing. The assembling stage focuses on the systematic identification and collection of relevant literature. The arranging stage involves screening and refining the dataset according to predefined inclusion and exclusion criteria. Finally, the assessing stage consists of analysing and synthesising the selected studies in order to interpret the intellectual development of the research domain and identify directions for future research.

Consistent with recent methodological approaches adopted in sustainability and management research, this review integrates bibliometric analysis with a structured thematic examination of the literature (Zupic and Čater 2015). In addition, the study incorporates a structured content analysis of the selected articles, enabling a deeper interpretation of bibliometric and thematic patterns. Bibliometric techniques enable the quantitative exploration of scientific production by analysing publication patterns, citation structures, collaboration networks, and keyword relationships within a specific research field. These approaches are increasingly used in systematic literature reviews because they allow researchers to investigate the intellectual and conceptual structure of a research domain through reproducible analytical procedures.

The integration of bibliometric methods with systematic review protocols allows for a comprehensive understanding of the evolution of a research field by combining quantitative mapping of the scientific landscape with qualitative interpretation of research themes and theoretical orientations. The inclusion of content-based coding further strengthens this approach by linking quantitative evidence to the underlying characteristics of the literature. This combined approach is particularly suitable for emerging and interdisciplinary topics, such as ESG reporting in extractive industries, where the literature is characterised by heterogeneous methodological approaches and theoretical perspectives.

Following the SPAR-4-SLR protocol, the methodological process adopted in this study is structured into the three stages described below. The overall review procedure is illustrated in Figure 1, which summarises the main stages of the SPAR-4-SLR protocol and the dataset construction process.

3.1 | Assembling

The assembling stage focuses on identifying and retrieving potentially relevant studies within the target research domain. This phase involves defining the scope of the review, selecting the bibliographic database, and establishing the search strategy used to collect the initial dataset of publications.

For this study, the Scopus database was selected as the primary source of bibliographic records. Scopus is widely used in systematic literature reviews due to its extensive coverage of peer-reviewed academic journals and its advanced indexing and citation tracking functionalities (Mongeon and Paul-Hus 2016). Its multidisciplinary scope and broad journal coverage make it particularly suitable for research topics located at the intersection of sustainability, management, and extractive industries.

The search strategy was designed to capture the main terminological variations used in the literature to refer to ESG and sustainability reporting within extractive sectors. To maximise the comprehensiveness of the search, Boolean operators and wildcard characters were used to include alternative expressions and spelling variations of key concepts. The final search query was applied to the TITLE-ABS-KEY fields of the Scopus database: TITLE (mining OR “extractive industr*” OR quarry*) AND TITLE-ABS-KEY ((report* W/3 sustainab* OR “non-financial” W/3 report* OR CSR W/3 (report* OR disclosure) OR ESG W/3 report* OR “environmental disclosure”)).

The search was conducted in February 2026 and covered the period 2000–2025. The initial Scopus search returned 228 records, which constituted the preliminary dataset for the subsequent screening phase.

3.2 | Arranging

The arranging stage focuses on organising and refining the dataset by applying inclusion and exclusion criteria in order to identify the final sample of relevant studies.

Only peer-reviewed journal articles published in English were included in the review. Conference papers, book chapters, and non-academic publications were excluded to ensure the quality and comparability of the analysed sources. Furthermore, each article was screened to verify its explicit focus on sustainability, ESG, or non-financial reporting practices within the mining and extractive industries.

After the initial Scopus search and the application of database filters (journal source type, document types “Article” and “Review”, and English language), the dataset was subjected to a manual screening process. This step aimed to verify the effective relevance of each record with respect to the research focus of the review.

During the manual screening phase, articles were excluded when the use of mining-related keywords was ambiguous or unrelated to the extractive sector (e.g., text mining or data mining studies), when the paper focused on sectors other than mining or extractive industries, or when the study addressed

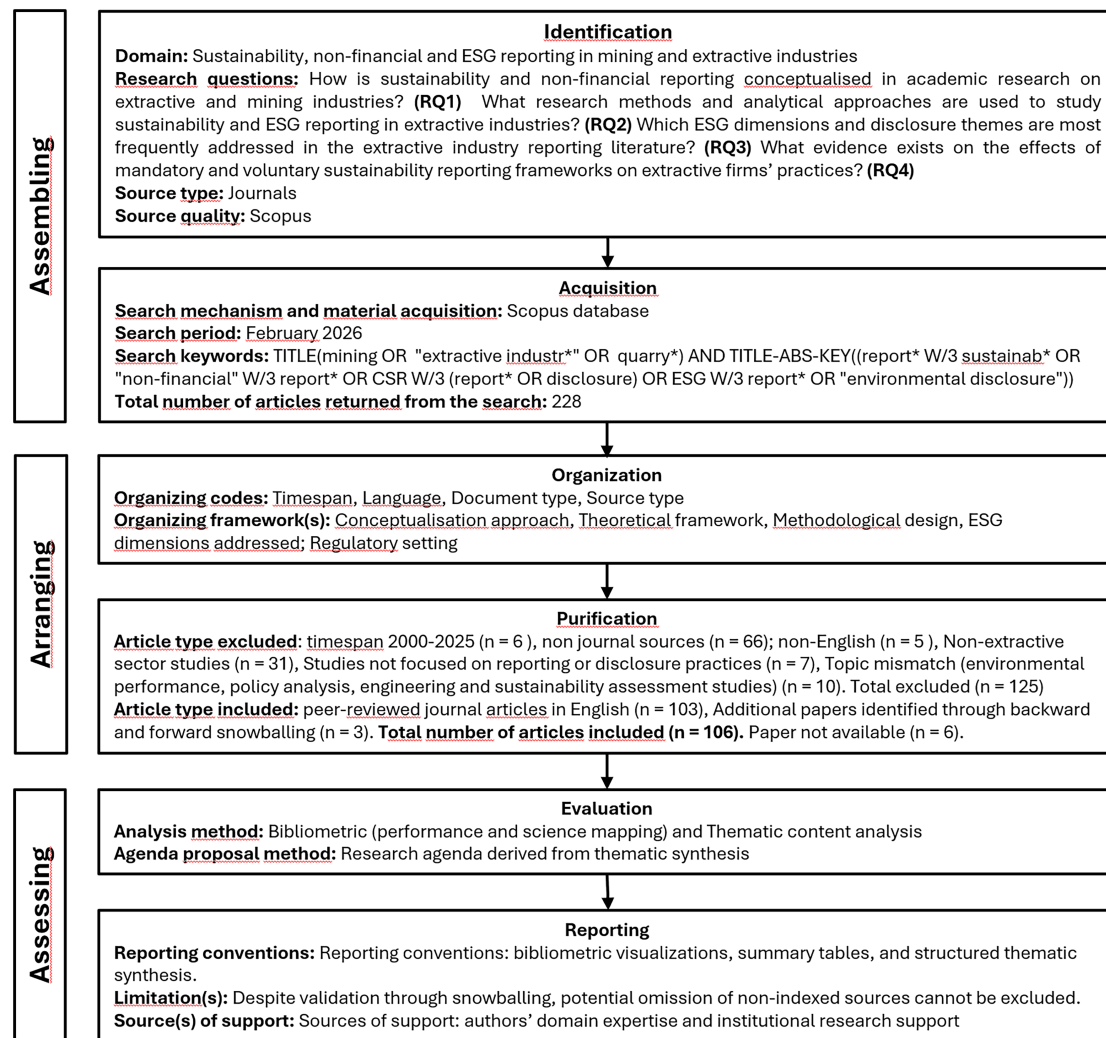


FIGURE 1 | Research design based on the SPAR-4-SLR protocol. The figure illustrates the main stages of the systematic literature review process, including assembling, arranging, and assessing.

methodological aspects of reporting without analysing reporting or disclosure practices in extractive contexts.

The screening process was conducted through the examination of titles, abstracts, and when necessary the full text, and each record was coded in an Excel database indicating inclusion or exclusion and the corresponding reason for exclusion. This procedure was adopted to ensure methodological transparency and replicability of the selection process.

After the screening process, the dataset consisted of 103 articles retrieved from Scopus. To enhance the completeness and robustness of the dataset, a snowballing procedure was subsequently conducted after the initial Scopus-based search and screening process. Following established systematic review protocols (Massaro et al. 2016), backward and forward snowballing were used as validation techniques rather than as primary search strategies. Backward snowballing involved screening the reference lists of the most conceptually relevant and highly cited articles included in the sample. Forward snowballing was performed through citation tracking in Scopus to identify subsequent studies citing these core contributions.

The objective of this step was threefold: (i) to verify that no seminal or highly influential studies were omitted due to terminology variations; (ii) to detect potentially relevant papers addressing ESG or sustainability reporting in the extractive sector under alternative labels, such as non-financial disclosure, corporate transparency, or sustainability communication; and (iii) to mitigate potential database bias and increase the internal validity of the review.

All additional papers identified through snowballing were subjected to the same inclusion and exclusion criteria applied in the main screening phase. Only studies explicitly focused on reporting or disclosure practices within mining or extractive industries, and published in peer-reviewed journals in English, were retained.

The snowballing procedure identified three additional relevant articles. After incorporating these contributions, the final dataset consisted of 106 peer-reviewed journal articles analysing sustainability and ESG reporting practices within extractive industries. Although the snowballing step did not substantially alter the final

dataset, it provided additional confidence regarding the completeness of the dataset and its methodological consistency.

This process enhances the transparency and reproducibility of the review, ensuring that the final dataset accurately represents the core literature on ESG reporting in extractive industries.

3.3 | Assessing

The assessing stage involves analysing and interpreting the selected literature in order to identify the intellectual, conceptual, and structural characteristics of the research field.

To provide a comprehensive understanding of the field, this study adopts a mixed-method approach combining bibliometric analysis, thematic analysis, and structured content analysis.

In this study, the selected dataset of 106 articles was examined through bibliometric science mapping techniques combined with thematic interpretation of the literature. Bibliometric analyses were conducted using Bibliometrix, an R-based software package specifically developed for quantitative analysis of scientific literature (Aria and Cuccurullo 2017). The Biblioshiny interface was employed to generate descriptive statistics and visualisations related to publication trends, source impact, author productivity, institutional contributions, and geographical distribution of research.

To explore the conceptual structure of the field, a keyword co-occurrence analysis was conducted using VOSviewer (Van Eck and Waltman 2010), which enabled the identification of major thematic clusters and conceptual relationships between research topics. In addition, a thematic analysis was performed through co-word analysis based on authors' keywords. A thematic map was generated using Callon's centrality and density measures, allowing the classification of themes into motor, basic, niche, and emerging or declining categories.

The intellectual structure of the field was investigated through co-citation analysis (Small 1973) of cited authors and journals, allowing the identification of the main theoretical traditions underpinning sustainability reporting research in extractive industries.

Finally, a structured content analysis was conducted on the selected articles. Each study was manually coded using a pre-defined set of variables, including ESG dimensions addressed, research methods, and geographical context. This coding procedure was implemented using a structured database developed in Excel, ensuring consistency and traceability of the classification process. This step enables linking bibliometric and thematic patterns to the actual characteristics of the literature, providing a more nuanced interpretation of the field. To further strengthen the analytical framework, the results were interpreted through a Theory–Context–Characteristics–Method (TCCM) lens, allowing for a more systematic understanding of the conceptual, empirical, and methodological patterns emerging from the literature.

By integrating bibliometric, thematic, and content-based analyses, the assessing stage provides a comprehensive overview of

the evolution, structure, and emerging directions of sustainability reporting research within the mining and extractive sectors.

4 | Results

The temporal distribution of the selected studies reveals a relatively recent but rapidly expanding research field. The results are structured to address the four research questions guiding this review, covering theoretical foundations (RQ1), methodological approaches (RQ2), ESG dimensions (RQ3), and the role of voluntary and mandatory reporting frameworks (RQ4).

As shown in Figure 2, scientific production remained limited until the mid-2010s, followed by a sharp increase after 2018. This acceleration reflects the growing relevance of ESG-related issues within extractive industries, particularly in response to increasing regulatory pressure and the introduction of structured reporting frameworks, as highlighted in previous studies on the institutionalisation of sustainability reporting (de Villiers et al. 2014; Lodhia and Hess 2014).

The observed trend suggests that the topic has evolved from an emerging niche into a more structured research stream, although it still exhibits significant conceptual dispersion.

Overall, the dataset highlights a fragmented but dynamic field, with a wide variety of keywords and approaches, indicating that a shared theoretical foundation is still under development.

4.1 | Bibliometric Structure of the Field

The bibliometric analysis provides insights into the intellectual structure of the field by examining co-citation patterns and keyword relationships.

The co-occurrence analysis highlights the main conceptual clusters within the literature, revealing the central role of sustainability reporting and mining-related topics, in line with prior studies emphasising the relevance of disclosure practices in extractive sectors (Fonseca et al. 2014; Jenkins and Yakovleva 2006).

Table 1 complements the keyword co-occurrence network by reporting the most frequent author keywords, their occurrence, and their link strength within the conceptual structure of the field.

These findings provide a descriptive overview of the most recurrent themes in the literature (RQ3), highlighting a strong focus on sustainability reporting, CSR, and stakeholder-related concepts.

The results provide an initial descriptive overview of the most frequent topics in the literature, with sustainability reporting and mining-related terms emerging as the most recurrent keywords, alongside CSR and stakeholder-oriented concepts. The presence of keywords such as “global reporting initiative” and “stakeholder engagement” indicates the relevance of structured reporting frameworks and stakeholder-oriented practices, although a deeper conceptual interpretation is developed in the following sections.

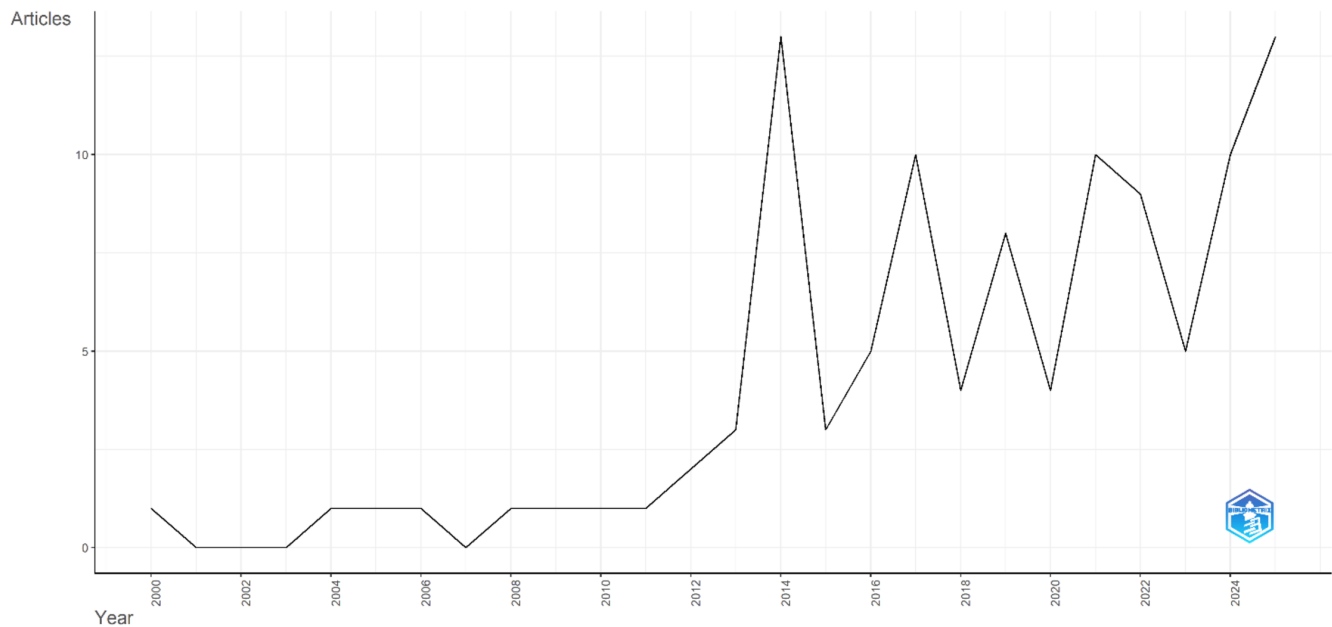


FIGURE 2 | Annual scientific production (2000–2025). *Source:* Authors' elaboration based on Bibliometrix.

TABLE 1 | Most frequent authors' keywords and network characteristics.

Rank	Author keywords	Occurrences	Total link strength	Cluster
1	Sustainability reporting	43	50	2
2	Mining	32	50	4
3	Sustainability	20	29	1
4	Corporate social responsibility	18	28	3
5	Mining industry	16	26	1
6	Sustainable development	14	28	3
7	Social license to operate	5	7	4
8	Stakeholders	5	5	1
9	Global Reporting Initiative	5	6	2
10	Stakeholder engagement	4	10	2

Source: Authors' elaboration based on Bibliometrix.

At this stage, the keyword analysis provides an initial descriptive overview of the main themes addressed in the literature. A more detailed interpretation of the conceptual structure and thematic relationships is developed in Section 4.2, while the distribution of ESG dimensions is further examined through content analysis in Section 4.4.

The co-citation network (Figure 3) reveals a structured intellectual landscape characterised by two main clusters.

The first cluster is centred on accounting and accountability journals, including *Accounting, Organisations and Society* and *Accounting, Auditing and Accountability Journal*, reflecting a strong focus on transparency, reporting practices, and corporate responsibility.

The second cluster is oriented towards environmental management and resource governance, with *Journal of Cleaner*

Production emerging as the most central and influential node, strongly connected to journals such as *Resources Policy* and *Sustainability*.

Journal of Business Ethics occupies an intermediate position, acting as a bridging node between the two clusters and linking accounting-oriented research with broader sustainability and management perspectives.

Overall, the network highlights the interdisciplinary nature of the field, positioned at the intersection of accounting, management, and environmental studies. The centrality of *Journal of Cleaner Production* suggests a progressive consolidation of sustainability reporting research within broader environmental and sustainability-oriented academic debates.

The concentration of the field within a limited number of publication outlets is further confirmed by Bradford's law (Figure 4)

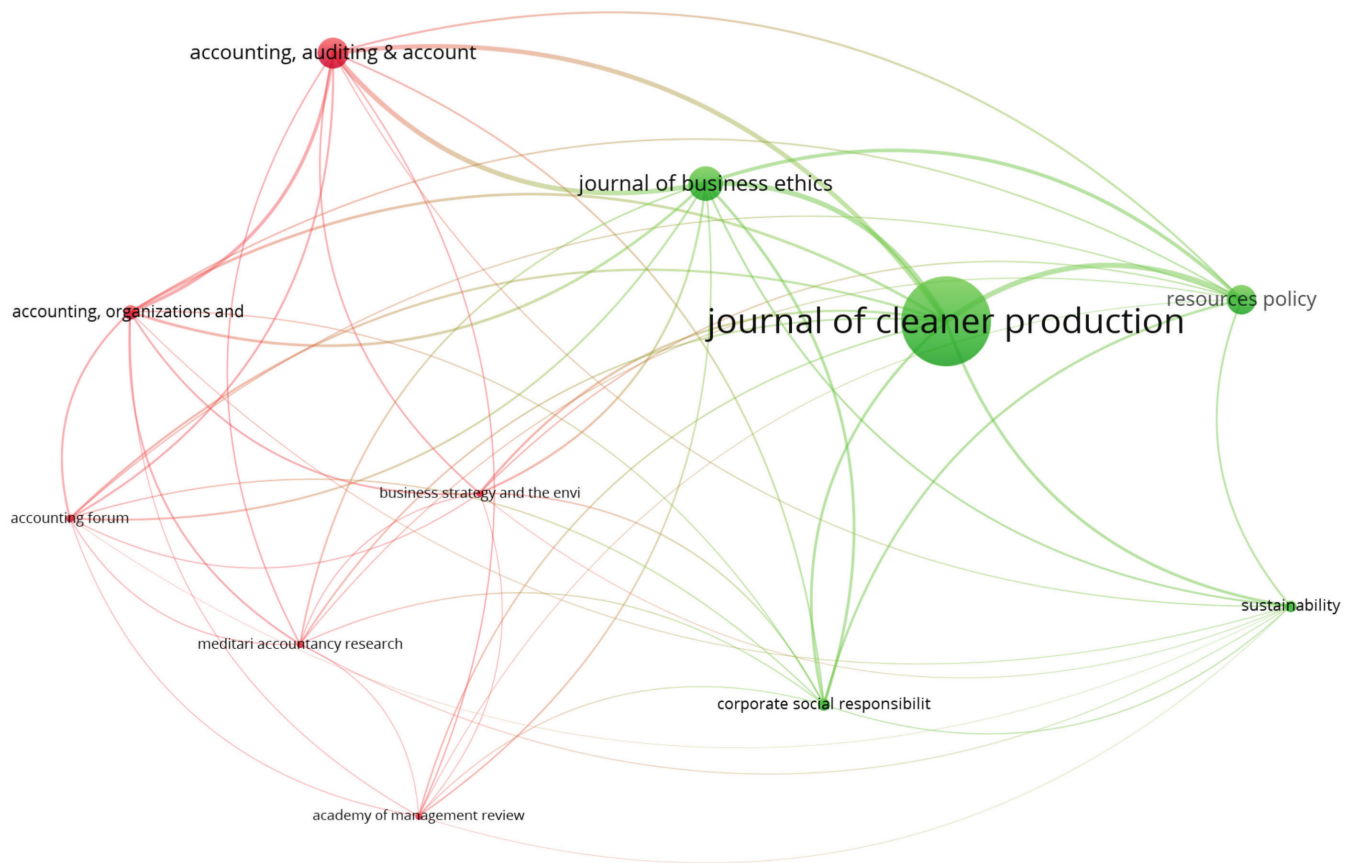


FIGURE 3 | Journal co-citation network. *Source:* Authors' elaboration based on VOSviewer.

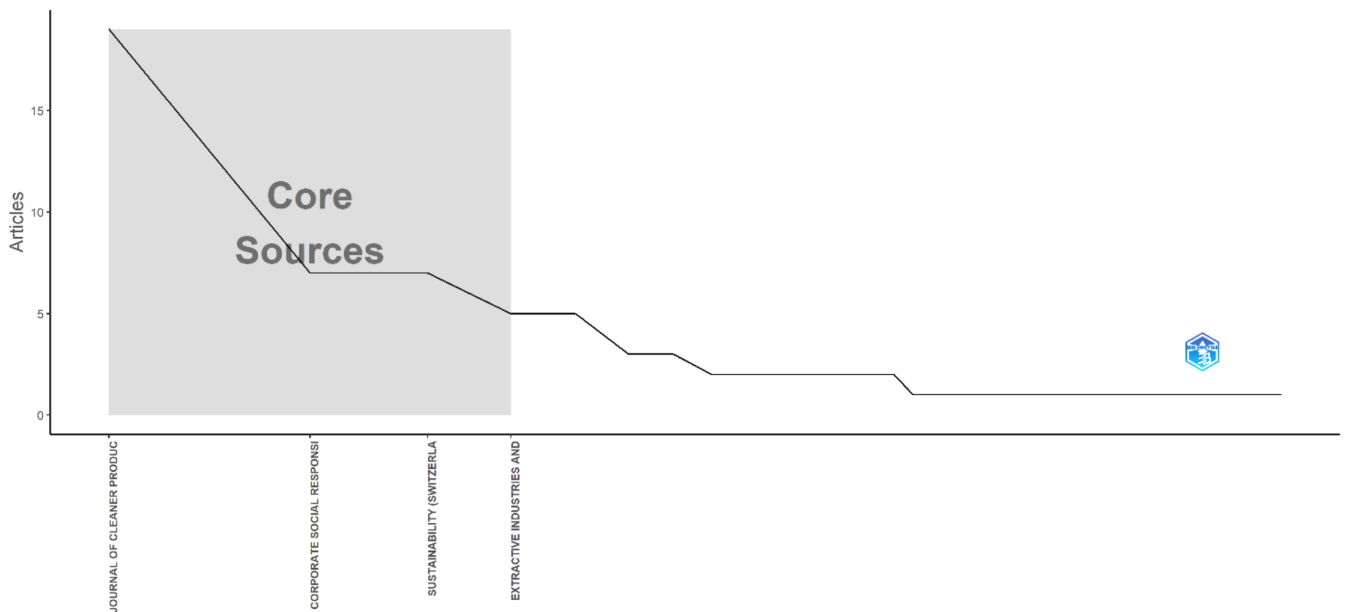


FIGURE 4 | Core sources identified through Bradford's law. *Source:* Authors' elaboration based on Bibliometrix.

(Borgohain et al. 2021), which identifies a small core of journals accounting for a substantial share of the total publications. In particular, Journal of Cleaner Production, CSR and Environmental Management, Sustainability, and Extractive Industries and Society emerge as the main publication outlets, confirming the

existence of a relatively well-defined journal nucleus despite the broader fragmentation of the field.

The author co-citation network (Figure 5) reveals three main and interconnected clusters, indicating a structured but not fully

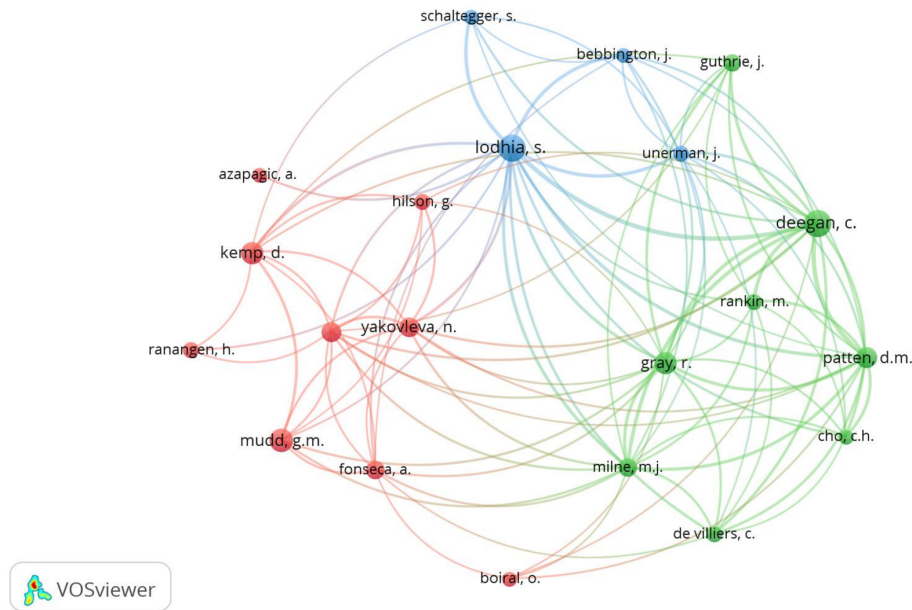


FIGURE 5 | Author co-citation network. *Source:* Authors' elaboration based on VOSviewer.

integrated intellectual landscape. Among the most prominent authors, Lodhia and Deegan emerge as the most influential, as reflected by the size of their nodes, followed by Mudd and Gray. In particular, Lodhia appears to occupy a relatively central position within the network, suggesting a bridging role across different streams of the literature.

Although three distinct clusters can be identified, comprising authors such as Deegan, Gray, Patten, Milne, Guthrie, and De Villiers (green cluster); Mudd, Kemp, Yakovleva, Fonseca, and Hilson (red cluster); and Lodhia, Unerman, Schaltegger, and Bebbington (blue cluster), the overall structure shows a significant degree of interconnection among them. This indicates that, despite the presence of identifiable intellectual groupings, the field is characterised by cross-fertilisation rather than strict fragmentation.

Taken together, these findings suggest that sustainability reporting in extractive industries is conceptualised through multiple, interrelated streams of research. The author co-citation network highlights groups of scholars who are frequently cited together, indicating the presence of distinct but interconnected intellectual traditions. While co-citation analysis does not directly capture research topics, these clusters can be cautiously interpreted in light of the main contributions of the authors involved. Overall, the interconnections among clusters suggest that the field is characterised by overlapping perspectives rather than clearly separated theoretical approaches.

To further characterise the field, the methodological approaches adopted in the reviewed studies were analysed.

Table 2 provides a detailed overview of the methodological approaches adopted in the reviewed studies.

The results show a predominance of quantitative studies, followed by qualitative approaches, while conceptual contributions

TABLE 2 | Distribution of methodological approaches in the reviewed studies.

Methodological approach	Number of studies	Percentage
Quantitative studies	58	54.7%
Qualitative studies	40	37.7%
Conceptual studies	8	7.5%
Total	106	100%

remain limited. Despite the growing presence of quantitative research, the field is still largely oriented towards descriptive and exploratory analyses rather than hypothesis testing or the development of predictive models. The limited use of large-scale and longitudinal data further constrains the robustness of empirical evidence.

These findings directly address RQ2, showing that, although quantitative approaches are prevalent, they are predominantly applied in descriptive and exploratory ways rather than for causal inference or predictive modelling.

4.2 | Thematic Evolution and Research Trends

The keyword analysis provides further insights into the conceptual development of the field and its evolution over time.

The keyword co-occurrence network (Figure 6) reveals a structured thematic landscape centred around sustainability reporting in extractive industries. Four main clusters can be identified.

The core of the network is represented by the cluster centred on mining sustainability reporting, which appears as the most prominent node and connects multiple research streams,

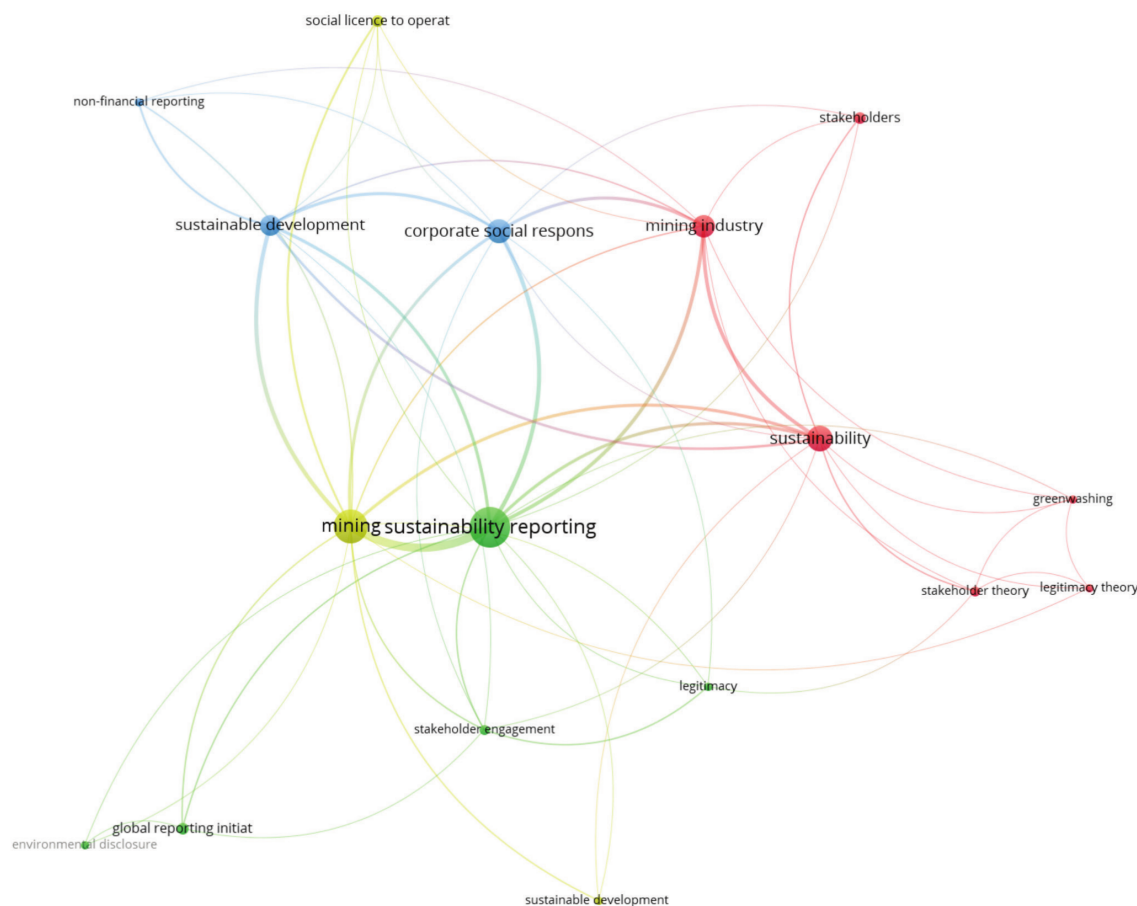


FIGURE 6 | Keyword co-occurrence network. *Source:* Authors' elaboration based on VOSviewer.

indicating its role as the central integrating theme of the field. This cluster is closely linked to practical tools and practices such as stakeholder engagement and reporting standards (e.g., GRI), reflecting the operationalisation of sustainability reporting in the mining sector.

A second cluster, located on the right side of the network, is associated with governance and theoretical perspectives, including keywords such as sustainability, stakeholders, legitimacy theory, and greenwashing. This stream highlights the growing importance of accountability, legitimacy, and institutional pressures in shaping ESG disclosure practices.

A third cluster, positioned on the upper left side, revolves around broader sustainability and reporting concepts, including CSR, sustainable development, and non-financial reporting. This indicates the theoretical roots of the field in CSR and general sustainability frameworks.

Finally, a smaller but distinct cluster relates to the social dimension of extractive activities, including concepts such as social licence to operate, reflecting the increasing relevance of societal acceptance and stakeholder relations in mining contexts.

Overall, the network suggests that the field is structured around a central reporting core, progressively integrating governance, theoretical, and social dimensions.

To further investigate the conceptual structure of the field, a thematic map (Figure 7) was developed using co-word analysis based on authors' keywords. The map classifies themes according to their centrality and density, enabling the identification of motor, basic, niche, and emerging or declining themes.

The results reveal a structured but still evolving research field characterised by a strong conceptual core and several emerging trajectories. Basic themes include sustainability reporting, CSR, and sustainable development, confirming the central role of traditional CSR-based frameworks in shaping the field. Motor themes are primarily associated with environmental issues, such as climate change, carbon emissions, and biodiversity, highlighting the increasing prominence of the environmental dimension within ESG research. This prominence of environmental themes is consistent with the long-standing focus on resource use, water management, and environmental performance in extractive industries (Mudd 2008; Northey et al. 2019).

Niche themes are related to context-specific and operational aspects, such as mining activities and geographically bounded studies, indicating a strong presence of case-based research. In contrast, emerging or declining themes include sustainability reporting in mining contexts and stakeholder engagement, which are positioned in the lower-left quadrant of the map, indicating low centrality and low density. This suggests that, despite their increasing relevance within the ESG debate, these topics are not

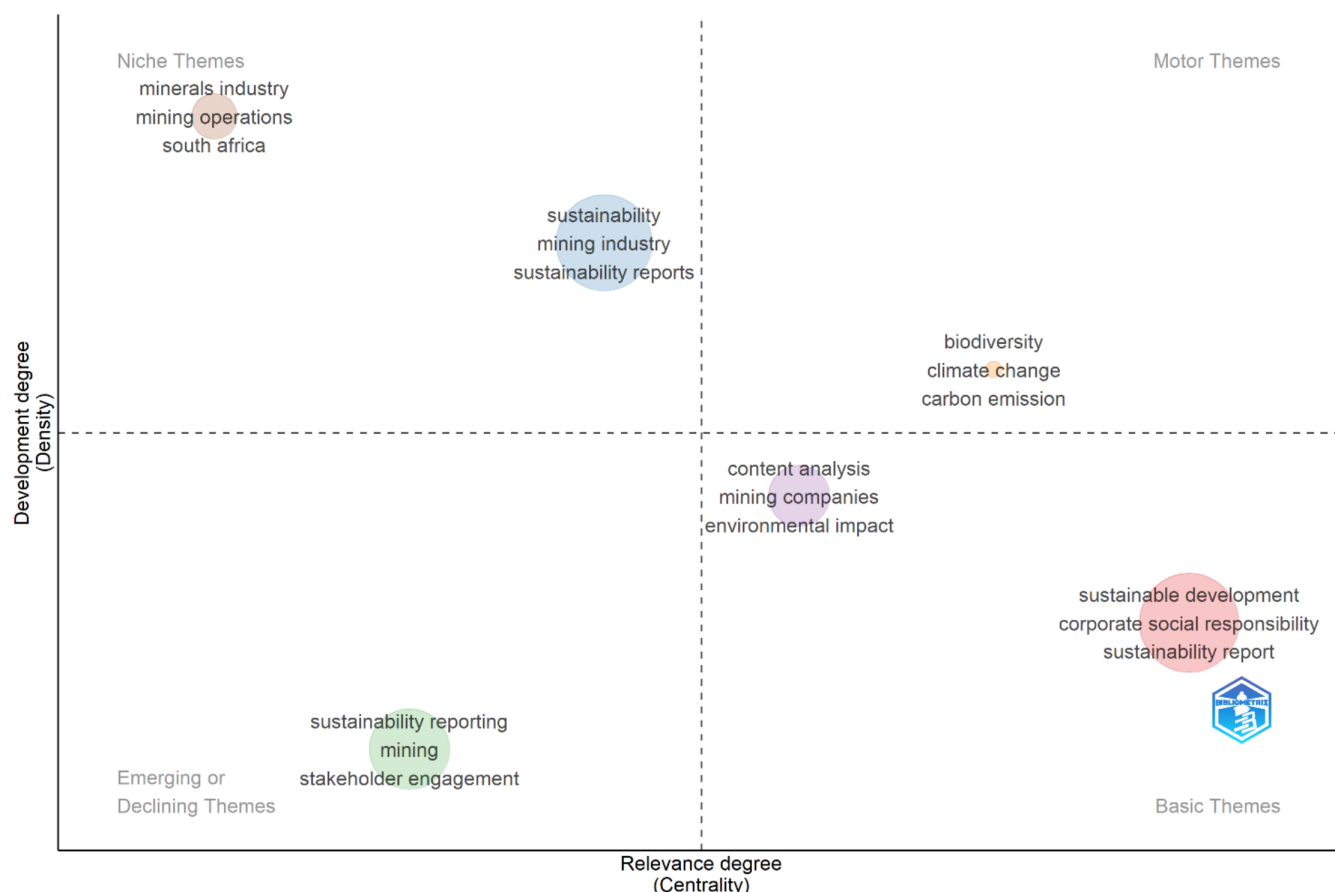


FIGURE 7 | Thematic map based on authors' keywords (Callon centrality and density). *Source:* Authors' elaboration based on Bibliometrix.

yet fully integrated into the core intellectual structure of the field and remain conceptually underdeveloped. This finding is particularly significant, as it suggests that, although sustainability reporting is highly central in terms of frequency and relevance, it has not yet reached a fully mature and theoretically consolidated stage within extractive industries research.

Overall, the thematic map highlights a field in transition, moving from traditional CSR-oriented approaches toward more integrated ESG and governance perspectives, while still lacking a fully consolidated and unified conceptual framework. In particular, the positioning of sustainability reporting within the emerging themes quadrant suggests that, despite its empirical centrality, its conceptual development is still evolving rather than fully established.

The temporal evolution of keywords (Figure 8) provides further insights into the dynamic development of the field. Unlike the co-occurrence network, the overlay visualisation reflects the average publication year of keywords, allowing the identification of emerging and declining research themes.

Early contributions, represented by blue nodes, are primarily associated with broad concepts such as CSR and sustainable development, indicating that the initial phase of the literature was grounded in general sustainability frameworks.

Intermediate developments, highlighted in green and yellow-green shades, include keywords such as non-financial reporting and mining industry, reflecting a transition toward more structured reporting practices and sector-specific applications. This phase marks the shift from generic sustainability concepts to more formalised disclosure approaches.

The most recent keywords, represented in yellow, are associated with governance and disclosure-related issues, such as greenwashing, legitimacy theory, and stakeholder theory. This suggests an increasing focus on transparency, accountability, and the strategic communication of ESG practices.

Overall, the temporal pattern reveals a transition from broad sustainability concepts to structured reporting practices and, more recently, to governance-oriented and legitimacy-driven perspectives, highlighting the progressive maturation of the field.

To further investigate the evolution of the conceptual structure, a temporal analysis of keyword occurrences was conducted (Figure 9), identifying three main phases in the development of the field: emergence (2000–2016), consolidation (2017–2019), and integration (2020–2025).

The emergence phase (2000–2016) is characterised by a strong focus on themes such as social licence to operate, stakeholders, sustainable development, and the GRI. During this period, the literature is predominantly grounded in legitimacy and

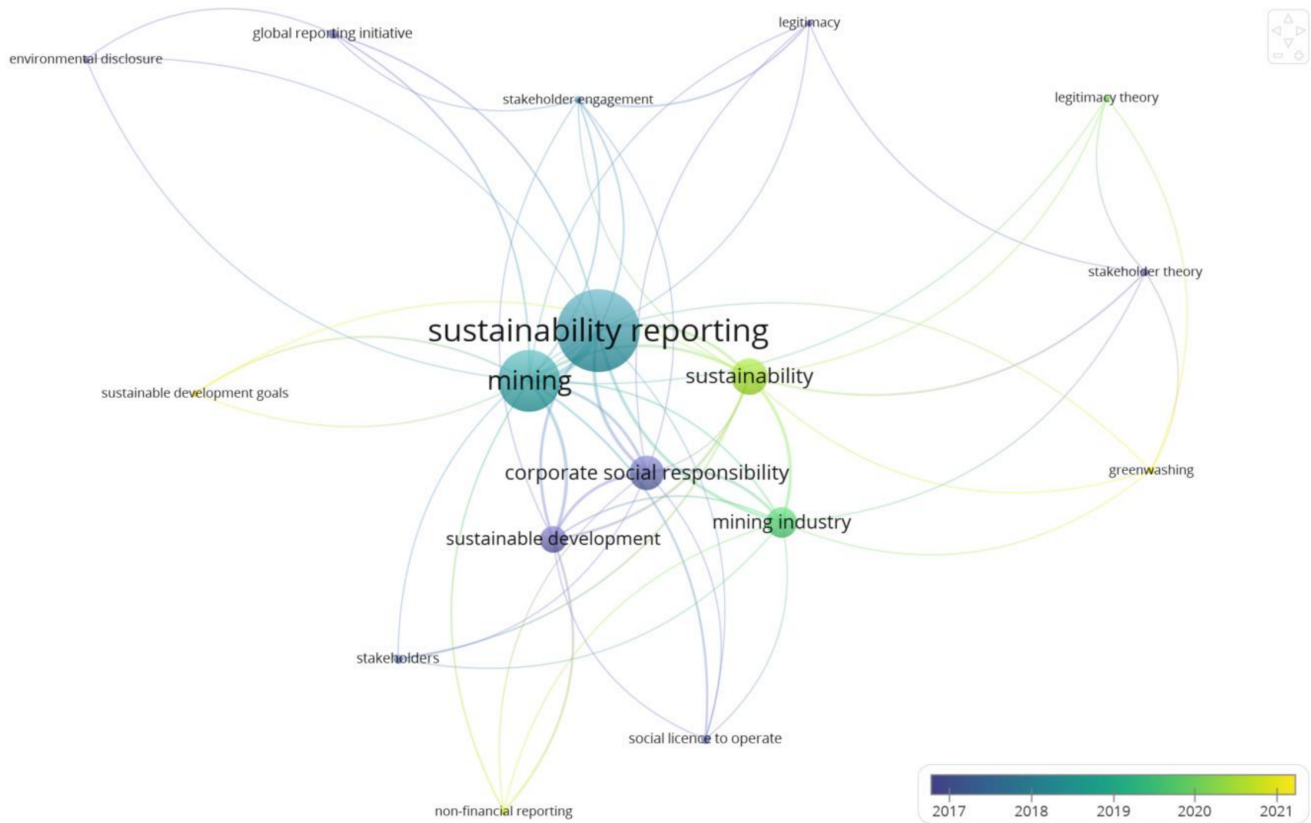


FIGURE 8 | Keyword temporal evolution (overlay visualisation). *Source:* Authors' elaboration based on VOSviewer.

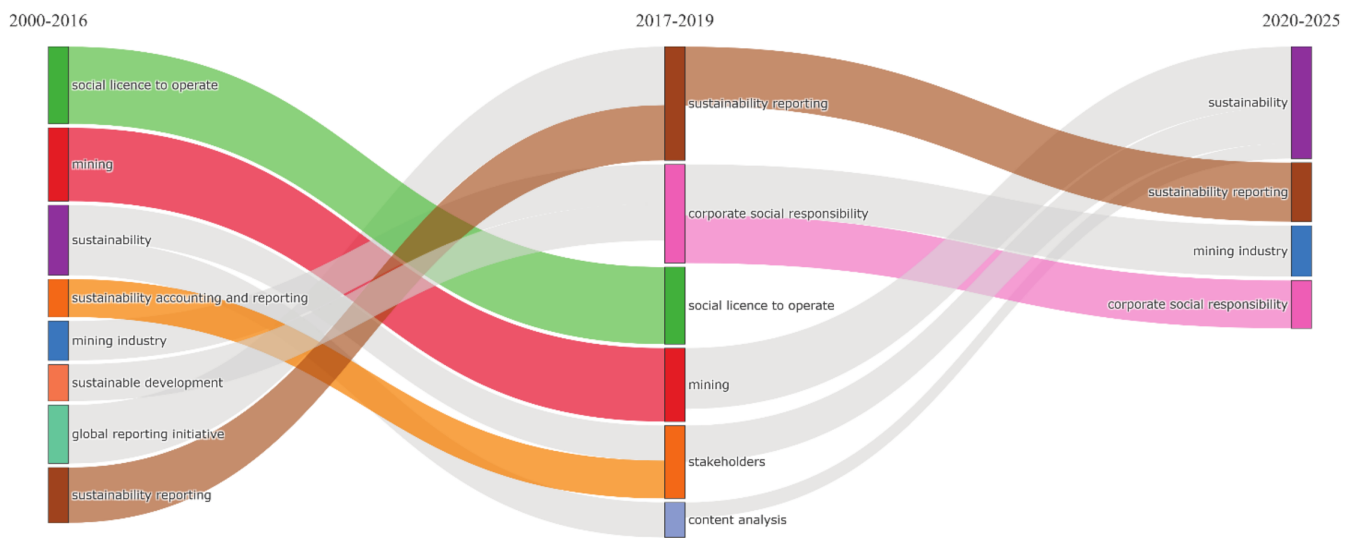


FIGURE 9 | Temporal evolution of keywords in sustainability reporting research in extractive industries. *Source:* Authors' elaboration based on Bibliometrix outputs.

stakeholder-oriented perspectives, reflecting an emphasis on industry accountability and the social and environmental pressures faced by extractive firms. Sustainability reporting is primarily interpreted as a tool for managing external expectations and securing societal acceptance.

The consolidation phase (2017–2019) marks a shift towards more structured and formalised approaches to sustainability disclosure. Key themes include CSR, sustainability reporting, and

mining, indicating the growing diffusion of CSR frameworks and more standardised reporting practices. This phase reflects a transition from stakeholder dialogue towards formal sustainability reporting, with increasing attention to disclosure structures and reporting frameworks.

In the most recent phase (2020–2025), the field exhibits a higher level of conceptual integration, with sustainability and

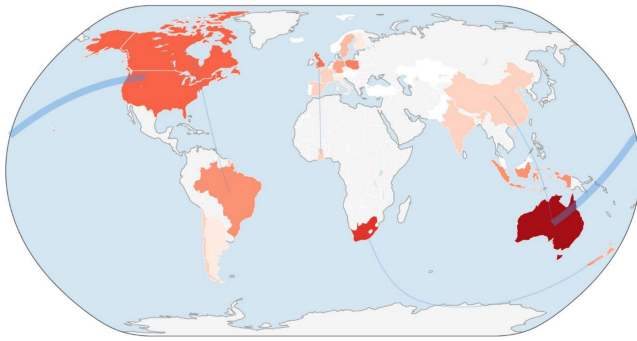


FIGURE 10 | Country scientific production and collaboration network. Source: Authors' elaboration based on Bibliometrix.

sustainability reporting emerging as dominant themes. The literature increasingly incorporates elements related to ESG integration, strategic sustainability management, and industry-specific reporting frameworks. This evolution suggests a progressive alignment of academic research with the institutionalisation of sustainability practices and the growing relevance of regulatory pressures and standardised ESG disclosure.

Overall, the temporal evolution highlights a trajectory from social legitimacy concerns to structured reporting frameworks and, more recently, towards integrated and strategic sustainability approaches. In the context of extractive industries, this shift reflects the combined influence of increasing regulatory pressure, the diffusion of ESG standards, and the broader institutionalisation of sustainability within corporate practices.

4.3 | Geographical Distribution and Collaboration Patterns

The geographical analysis highlights the distribution of scientific production and the structure of international collaborations.

The results (Figure 10) indicate a geographically concentrated research landscape, with significant contributions from countries such as the United States, Australia, and several European nations. Table 3 reports the leading countries in terms of scientific production.

Notably, Australia emerges as the dominant contributor, followed by the United Kingdom and South Africa, reflecting their strong involvement in extractive industries and related sustainability debates. European countries also contribute substantially to the literature, likely influenced by the development of regulatory frameworks and sustainability reporting directives, although their role appears more distributed rather than dominant.

South Africa also emerges as a relevant contributor, likely reflecting the importance of the mining sector in its national context.

In contrast, other regions, despite their central role in global extractive activities, remain comparatively underrepresented in the academic production.

The collaboration network reveals the presence of interconnected research hubs, particularly linking North America, Europe, and

TABLE 3 | Leading countries in scientific production on sustainability reporting in extractive industries.

Rank	Country	Number of publications
1	Australia	23
2	United Kingdom	12
3	South Africa	9
4	Indonesia	8
5	Poland	7
6	Brazil	5
7	Canada	5
8	United States	5
9	Germany	4
10	Spain	3

Source: Authors' elaboration based on Scopus data.

Australia, with South Africa representing a notable connection to resource-intensive contexts. These patterns suggest a partially globalised research field, still shaped by regional expertise and institutional contexts rather than fully distributed worldwide collaboration.

4.4 | Content-Based Analysis of the Literature

To complement the bibliometric and thematic analyses, a structured content analysis was conducted on the final dataset of 106 articles. This step allows linking the quantitative patterns identified through science mapping techniques with the underlying characteristics of the literature, providing a deeper understanding of how ESG reporting is empirically and conceptually addressed within extractive industries.

The analysis reveals a number of systematic imbalances and structural patterns that characterise the current state of the field.

First, with respect to reporting approaches, the literature is strongly dominated by voluntary disclosure practices. A large proportion of the analysed studies focus on voluntary sustainability reporting, while only a limited number explicitly address mandatory reporting frameworks. This finding highlights that the academic debate is still largely grounded in pre-regulatory or soft-law contexts, with comparatively limited attention to the implications of recent regulatory developments such as mandatory ESG disclosure frameworks. The presence of a subset of studies addressing both voluntary and mandatory approaches suggests an emerging transition phase, but the literature has not yet fully captured the shift toward formalised and standardised reporting regimes. These findings contribute to answering RQ4, indicating that the literature remains largely focused on voluntary disclosure practices, while the growing role of mandatory and standardised reporting frameworks is only partially addressed.

Second, the analysis of methodological approaches indicates a predominance of quantitative research designs. Quantitative studies account for the largest share of the literature, while

qualitative approaches, including content analysis and case studies, remain highly relevant. This distribution suggests that, although quantitative approaches are prevalent, the field remains largely oriented toward descriptive and exploratory analyses rather than hypothesis testing or the development of predictive models. The limited use of large-scale and longitudinal data further constrains the generalisability and robustness of existing findings.

Third, the distribution of ESG dimensions reveals a significant imbalance across the three pillars. The majority of studies focus on general sustainability reporting or environmental disclosure, while governance-related topics receive moderate attention and social dimensions remain largely underexplored, consistent with prior studies highlighting the environmental bias of sustainability reporting in extractive industries (Fonseca et al. 2014; Mancini and Sala 2018). This imbalance confirms that the literature is still heavily oriented toward environmental issues, with limited integration of social and governance aspects into a comprehensive ESG perspective. As a result, the multidimensional nature of ESG reporting is only partially reflected in current research, which tends to analyse its components in isolation rather than as an integrated framework. These findings address RQ3 by showing a clear imbalance across ESG dimensions, with environmental aspects dominating the literature, while social and governance issues remain comparatively underexplored. Fourth, the empirical focus of the literature is predominantly firm-level, with most studies analysing sustainability reporting practices at the level of individual companies. Industry-level analyses and cross-sector comparisons are comparatively limited. This micro-level orientation suggests that the literature prioritises organisational practices over systemic dynamics, potentially overlooking broader institutional, regulatory, and value-chain perspectives that are particularly relevant in extractive industries.

A further critical pattern emerges from the analysis of firm characteristics. The vast majority of studies focus on large corporations, while small and medium-sized enterprises (SMEs) are almost entirely absent from the literature. This strong bias toward large firms reflects both data availability and the visibility of major extractive companies, but it also represents a significant research gap, given the role of smaller actors in global supply chains and local extractive contexts.

Overall, the content-based analysis highlights a field that, despite its rapid growth, remains characterised by structural imbalances in terms of methodological approaches, thematic focus, and empirical coverage. The dominance of voluntary reporting, the prevalence of quantitatively oriented but predominantly exploratory methods, the environmental bias within ESG dimensions, and the concentration on large firms collectively indicate that the literature has not yet reached a fully mature and integrated stage.

These findings provide important insights for future research, suggesting the need for more quantitative and mixed-method studies, greater attention to social and governance dimensions, increased focus on mandatory reporting frameworks, and a broader inclusion of diverse organisational contexts, including SMEs and underrepresented geographical areas.

5 | Discussion

This study provides a comprehensive overview of ESG reporting in extractive industries and reveals a research field characterised not only by rapid growth, but by a structural misalignment between its increasing practical relevance and its still limited theoretical and empirical consolidation. While sustainability reporting has become a central governance mechanism in resource-intensive sectors, the academic literature has not yet fully developed the conceptual and methodological tools required to interpret this transformation.

The persistence of fragmentation within the field can be attributed to several interrelated factors. First, sustainability reporting in extractive industries has evolved at the intersection of multiple research traditions, including accounting, corporate social responsibility, environmental management, and mining studies. As a result, different scholarly communities have often developed parallel research streams characterised by distinct theoretical assumptions, methodological preferences, and publication outlets. Second, the historical development of the field has been strongly influenced by CSR and legitimacy-oriented perspectives, which emerged before the widespread adoption of ESG frameworks and continue to shape much of the contemporary literature. Third, substantial differences in regulatory environments across countries have contributed to the development of geographically specific research agendas, limiting theoretical convergence. Finally, the predominance of case-study and context-dependent approaches has generated valuable empirical insights but has also constrained the development of cumulative and generalisable knowledge.

The dominance of journals such as *Journal of Cleaner Production*, *Corporate Social Responsibility and Environmental Management*, and *Resources Policy* can be interpreted within this context. These outlets occupy a strategic position at the intersection of sustainability, governance, and resource management research, providing a natural venue for studies that address ESG reporting in extractive sectors. Their centrality therefore reflects not only publication patterns but also the intellectual structure of the field itself.

The thematic clusters identified through the keyword co-occurrence network (Figure 6) and thematic map (Figure 7) are also reflected in several seminal and influential contributions that have shaped the evolution of sustainability reporting research in extractive industries. Early studies focused primarily on CSR and stakeholder-related disclosure practices. In particular, Jenkins (2004) and Jenkins and Yakovleva (2006) highlighted the growing importance of CSR and voluntary sustainability reporting within the mining sector, emphasising the role of transparency, stakeholder relations, and corporate legitimacy.

Subsequent research increasingly examined the content, credibility, and comparability of sustainability disclosures. Studies such as Perez and Sanchez (2009), Fonseca (2010), and Fonseca et al. (2014) critically assessed sustainability reporting practices and highlighted persistent challenges related to reporting consistency, comparability, and the effective application of reporting frameworks. Similar concerns were later reinforced by Amoako

et al. (2017), who identified substantial variations in sustainability reporting practices across mining operations.

A further stream of research investigated sustainability reporting through legitimacy and stakeholder perspectives. Coetzee and Van Staden (2011), Murguía and Böhling (2013) highlighted the limitations of sustainability disclosures in addressing stakeholder concerns and socio-environmental conflicts, while Böhling et al. (2019) emphasised the role of reporting in legitimacy construction and the pursuit of a social licence to operate. More recent contributions have increasingly explored the integration of sustainability within organisational strategies, governance systems, and business models. For example, de Villiers et al. (2014) examined the institutionalisation of sustainability disclosure practices, while Bini et al. (2018) analysed the integration of sustainability considerations into mining companies' business model disclosures. Together, these contributions illustrate the progressive evolution of the field from CSR-oriented reporting towards broader ESG, accountability, and governance-oriented perspectives.

The implications of this fragmentation are significant. While conceptual diversity has enriched the literature, it has also limited the development of integrated theoretical frameworks and reduced the comparability of empirical findings across studies. Consequently, the field risks generating fragmented evidence that is difficult to translate into coherent governance, regulatory, and managerial recommendations.

Building on the empirical evidence presented in Section 4, particularly the dominance of voluntary disclosure practices (RQ4), the imbalance across ESG dimensions (RQ3), and the fragmentation of theoretical perspectives (RQ1), the results of this study can be interpreted through a transition framework that conceptualises sustainability reporting along two main dimensions: (i) from voluntary to mandatory disclosure regimes, and (ii) from legitimacy-driven communication to governance-oriented practices. This transition framework is illustrated in Figure 11.

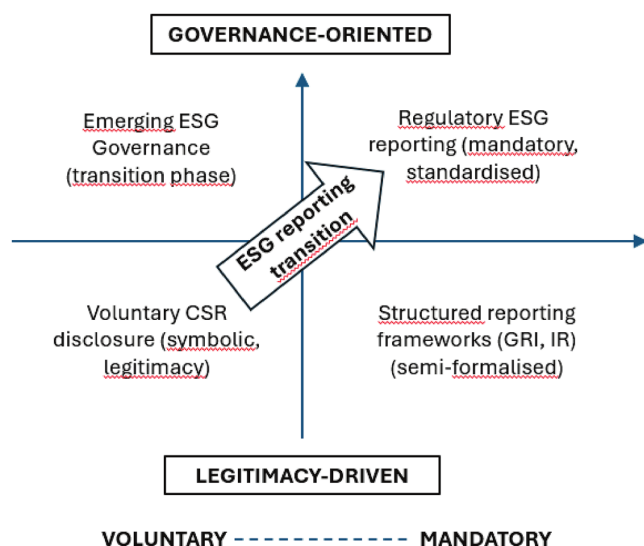


FIGURE 11 | Conceptual transition framework of ESG reporting in extractive industries. Source: Authors' elaboration.

Within this framework, ESG reporting in extractive industries appears to be shifting from a flexible and symbolic tool used to manage stakeholder perceptions toward a more formalised mechanism embedded in regulatory compliance and organisational decision-making processes. However, this transition remains incomplete, as the literature continues to be predominantly anchored in earlier interpretative models.

Beyond its descriptive function, this framework may also be interpreted as a theoretical lens for understanding the evolution of ESG reporting in extractive industries. Specifically, it suggests that reporting practices are increasingly shaped by the interaction of four interconnected mechanisms: legitimacy-seeking behaviour, stakeholder engagement, institutional pressures, and regulatory formalisation. Rather than treating environmental, social, and governance dimensions as separate domains, the framework conceptualises them as components of a broader governance system through which organisations manage accountability, transparency, and sustainability performance. In this sense, the framework offers a potential pathway for reducing the fragmentation that currently characterises the literature and provides a foundation for future theory-building efforts.

The findings of this review are further reinforced by recent contributions, which suggest a growing convergence between sustainability disclosure and broader corporate reporting strategies. In particular, emerging studies indicate that ESG-related information is increasingly embedded within integrated reporting processes, reflecting a shift from standalone sustainability communication towards more structured and strategic disclosure practices (Haywood et al. 2026; Sreenu 2026). Similarly, the recent systematic literature review by Essajide et al. (2026) highlights the growing interconnection between ESG disclosure and green innovation, further supporting the view that sustainability reporting is progressively evolving from a disclosure-oriented practice towards a more strategic governance mechanism.

From a theoretical perspective, the findings indicate that the field remains predominantly anchored in traditional frameworks such as stakeholder theory and legitimacy theory, which continue to serve as the primary lenses for interpreting sustainability disclosure and corporate accountability practices. These perspectives, historically rooted in the development of CSR, remain highly relevant in explaining why firms engage in reporting activities, particularly in contexts characterised by high environmental and social exposure. However, the persistence of these frameworks also suggests a limited theoretical evolution, as emerging governance-oriented perspectives have not yet been fully integrated into a coherent and unified conceptual structure.

Rather than representing a consolidated research domain, ESG reporting in extractive industries appears as a field in transition, still largely grounded in CSR-based interpretative approaches while progressively incorporating elements related to transparency, accountability, and regulatory compliance, as also highlighted in prior studies on sustainability reporting in mining contexts (Fonseca 2010). This transition is reflected in the thematic positioning of key constructs such as sustainability reporting and stakeholder engagement, which, despite their central role in practice, remain located within the emerging themes quadrant. This misalignment indicates that the conceptual development of the

field is lagging behind its practical relevance, highlighting the need for more integrative and theoretically robust approaches.

The thematic evolution identified in the bibliometric analyses also appears closely associated with broader institutional and regulatory developments. The early emphasis on CSR, sustainable development, and stakeholder-related concepts reflects the growing attention devoted to corporate responsibility during the 2000s, supported by the progressive diffusion of GRI reporting standards. Subsequently, the adoption of the United Nations Sustainable Development Goals (SDGs) in 2015, the increasing relevance of ESG investing, and the growing demand for non-financial transparency contributed to the expansion of sustainability reporting research. More recently, the emergence of mandatory disclosure frameworks and sustainability reporting standards has accelerated the shift towards governance-, accountability-, and transparency-oriented perspectives. Consequently, the evolution of the literature appears to mirror broader transformations occurring within the institutional environment of extractive industries.

The position of stakeholder engagement among the emerging themes is particularly noteworthy. Although stakeholder-related concepts have historically played a central role within legitimacy and social licence to operate frameworks, their integration into contemporary ESG reporting research remains limited. Future studies could contribute to advancing this stream by examining how stakeholder engagement influences reporting quality, how local communities and indigenous groups are represented within disclosure processes, and whether participatory approaches can reduce symbolic reporting and greenwashing risks. Such research would help bridge the current gap between stakeholder theory and governance-oriented ESG frameworks.

A key tension emerging from the analysis concerns the shift from voluntary to mandatory reporting regimes. The literature has traditionally framed sustainability reporting as a voluntary, legitimacy-driven practice, allowing firms to strategically manage stakeholder expectations and reputational risks. However, previous research has highlighted significant limitations of voluntary disclosure practices, particularly in terms of credibility and comparability, pointing to the risk of symbolic reporting (Boiral and Henri 2017). In parallel, recent regulatory developments are progressively redefining reporting as a formalised governance mechanism. This transition is further complicated by the evolving and fragmented nature of the regulatory landscape, where the introduction of mandatory disclosure requirements varies significantly across jurisdictions, in terms of timing, scope, and implementation. As a result, the limited attention to mandatory frameworks in the academic literature may partly reflect this institutional uncertainty rather than a lack of relevance of regulatory developments. At the same time, this context suggests that firms have increasingly engaged in voluntary ESG disclosure practices, anticipating regulatory developments and responding proactively to stakeholder expectations. This dynamic introduces a critical trade-off between flexibility and standardisation: voluntary disclosure enables firms to tailor communication strategies but often results in selective or symbolic practices, whereas mandatory frameworks enhance comparability and accountability, yet may encourage compliance-oriented behaviours without necessarily improving substantive environmental and social performance.

This interpretation is consistent with earlier evidence from the mining sector suggesting that sustainability reporting may fail to address stakeholders' critical concerns and, in some cases, may even exacerbate tensions when disclosure is perceived as disconnected from local environmental and social issues (Murguía and Böhling 2013). These findings further reinforce the importance of stakeholder engagement as a central component of credible and effective ESG reporting practices. This tension represents a central axis along which the future evolution of the field is likely to unfold.

From a contextual perspective, the literature is characterised by a strong geographical concentration, with a predominance of studies focusing on developed economies such as the United States, Australia, and European Countries. These contexts, typically associated with more advanced regulatory environments and established reporting practices, play a dominant role in shaping the academic discourse. Conversely, resource-intensive regions and emerging economies remain underrepresented, despite their critical importance in global extractive activities. This imbalance suggests the presence of a structural bias in the current body of knowledge and limits the generalisability of existing findings. At the same time, context-specific research streams highlight the importance of institutional environments, although these studies often remain weakly connected to broader comparative frameworks.

Several factors may explain the underrepresentation of resource-intensive regions such as Latin America, Central Asia, and parts of Africa within the academic literature. These include language barriers, lower representation of regional journals within international databases, differences in research funding capacity, and varying levels of institutionalisation of sustainability reporting practices. In addition, regulatory requirements concerning ESG disclosure remain highly heterogeneous across jurisdictions, influencing both corporate reporting behaviour and scholarly attention. As a consequence, some of the regions most directly affected by extractive activities are only marginally represented within the dominant academic discourse, limiting the global applicability of existing findings.

The collaboration patterns identified in the bibliometric analysis also have important implications. While international collaborations contribute to knowledge diffusion and methodological convergence, they are concentrated within a relatively small group of countries and institutions. This concentration may facilitate the development of common theoretical and methodological standards, but it may also reinforce dominant perspectives originating from developed economies. Consequently, locally specific governance challenges, stakeholder relationships, and reporting practices may remain insufficiently captured within the broader literature. Expanding collaboration networks to include a greater diversity of geographical and institutional contexts could therefore enhance both the relevance and robustness of future ESG reporting research in extractive industries. This could be achieved through stronger international research partnerships, greater inclusion of institutions from underrepresented extractive regions in collaborative projects, and broader support for comparative cross-country research initiatives.

The thematic structure of the literature reveals further imbalances. Environmental issues, particularly those related to

climate change, carbon emissions, and biodiversity, emerge as the most developed and central research themes. In contrast, social and governance dimensions are comparatively underexplored and often fragmented. This asymmetry suggests that the literature does not yet fully capture the multidimensional nature of ESG reporting, tending instead to prioritise environmental performance over integrated sustainability perspectives. Several factors may explain this imbalance. Environmental issues have historically represented the most visible and measurable consequences of extractive activities and have therefore attracted greater regulatory attention, public scrutiny, and corporate disclosure efforts. In contrast, social and governance dimensions are often characterised by greater contextual variability, making them more difficult to standardise and compare across firms and jurisdictions. Social issues frequently depend on local stakeholder relationships, community expectations, and cultural contexts, while governance practices are strongly influenced by institutional and regulatory environments. As a result, these dimensions have received comparatively less systematic attention within both corporate reporting practices and academic research. Importantly, this imbalance has direct implications for sustainability transitions, as it indicates that current reporting practices may only partially support the shift towards more sustainable and resource-efficient production systems in extractive industries.

From a methodological standpoint, the field shows a predominance of quantitative approaches, although these are largely applied in descriptive and exploratory ways rather than for causal inference or predictive modelling. Quantitative studies account for the largest share of the literature, while qualitative contributions, including content analysis and case studies, continue to play a central role in understanding reporting practices. Conceptual studies remain comparatively limited.

Despite the growing presence of quantitative research, the field is still largely oriented towards descriptive and exploratory analyses rather than hypothesis testing or the development of predictive models. The limited use of large-scale and longitudinal data further constrains the robustness of empirical evidence. In addition, the strong focus on large corporations introduces a structural bias, as small and medium-sized enterprises, despite their relevance within extractive value chains, remain largely overlooked. Taken together, these findings suggest that ESG reporting in extractive industries is evolving from a predominantly communicative and legitimacy-driven practice towards a potential governance tool capable of supporting sustainability transitions. However, this evolution remains incomplete. The coexistence of fragmented theoretical approaches, methodological limitations, and contextual biases indicates that the field has not yet achieved full conceptual and empirical maturity, reinforcing earlier evidence on the evolving and fragmented nature of sustainability reporting research in extractive industries (Fonseca et al. 2014). As a result, the effectiveness of sustainability reporting in driving substantive environmental and social performance improvements remains uncertain.

These results have several implications for future research and practice. From a research perspective, greater effort is needed to develop integrative theoretical frameworks capable of connecting legitimacy, stakeholder, institutional, and governance perspectives within a unified understanding of ESG reporting.

Such theoretical integration would provide a stronger foundation for future theory-driven research and facilitate the progressive transition from predominantly descriptive and exploratory studies towards more explanatory investigations of ESG reporting in extractive industries. Expanding the geographical scope of analysis is essential to achieve a more globally representative understanding of extractive industries. In addition, greater attention should be devoted to SMEs and underrepresented geographical regions, which remain comparatively neglected in the current literature. Comparative and longitudinal studies should also be prioritised to improve the robustness and generalisability of empirical evidence, while methodological advancements may be achieved through the wider adoption of quantitative and mixed-method approaches. Future studies should explicitly address the implications of regulatory developments and the transition towards mandatory reporting frameworks, which are likely to play a central role in shaping the evolution of ESG reporting in the coming years. Particularly relevant questions include how mandatory reporting requirements influence disclosure quality and organisational behaviour, how stakeholder engagement affects the credibility and effectiveness of ESG reporting, and how ESG reporting can be more effectively integrated into corporate governance and strategic decision-making processes. Further research is also needed to examine ESG reporting practices in emerging and resource-dependent economies, as well as among SMEs and junior mining companies, which remain significantly underrepresented in the existing literature.

From a practical perspective, the findings suggest that firms should move beyond compliance-oriented disclosure practices and strengthen the integration of ESG reporting within strategic decision-making processes. Regulators may contribute to reducing fragmentation by promoting greater harmonisation among reporting standards and improving the comparability of sustainability disclosures across jurisdictions. At the same time, stronger stakeholder engagement mechanisms could help improve the credibility, relevance, and accountability of reporting practices.

More broadly, the consolidation of the field will require closer interaction among researchers, practitioners, regulators, and civil society organisations. Such collaboration should not only promote knowledge exchange but also encourage the progressive harmonisation of reporting practices, the development of shared methodological approaches, and greater consistency in ESG reporting standards across jurisdictions. Ultimately, these efforts may facilitate the development of more consistent reporting frameworks and contribute to transforming ESG reporting from a disclosure exercise into an effective governance mechanism supporting sustainability transitions in extractive industries.

To translate the identified gaps into actionable pathways for future development, Table 4 summarises the main challenges emerging from the literature together with potential actions for researchers, practitioners, regulators, and civil society actors.

6 | Conclusions

This study provides a structured and integrative synthesis of ESG and sustainability reporting in extractive industries, revealing a

TABLE 4 | Pathways for advancing ESG reporting research and practice in extractive industries.

Stakeholder group	Key challenges identified	Recommended actions
Researchers	Fragmented theoretical foundations; limited integration of ESG dimensions; geographical concentration of studies	Develop integrative frameworks linking legitimacy, stakeholder, institutional, and governance perspectives; expand research in underrepresented regions; increase the use of longitudinal and comparative studies
Industry practitioners	Predominance of compliance-oriented reporting; limited integration of social and governance dimensions	Embed ESG reporting within strategic decision-making processes; strengthen stakeholder engagement mechanisms; improve integration across E, S, and G dimensions
Regulators and standard setters	Heterogeneity of reporting requirements; limited comparability across jurisdictions	Promote greater harmonisation among sustainability reporting standards; strengthen disclosure guidance; improve comparability and accountability mechanisms
Civil society and local stakeholders	Limited representation within reporting processes; concerns regarding transparency and credibility	Encourage participatory reporting approaches; strengthen monitoring and verification processes; support mechanisms that improve accountability and trust
Research–practice ecosystem	Weak integration between academic knowledge and reporting practice	Foster collaboration among researchers, companies, regulators, and stakeholders to support the development of more robust and effective ESG reporting frameworks

research field that is expanding rapidly but remains characterised by fragmentation, conceptual dispersion, and limited theoretical consolidation. Despite the increasing strategic importance of ESG reporting in resource-intensive sectors, the academic literature has not yet fully developed a coherent framework capable of capturing its evolving role.

The findings highlight that the field is still largely anchored in traditional CSR- and legitimacy-based perspectives, while a fully integrated ESG and governance-oriented approach is only beginning to emerge. This suggests that academic research is lagging behind practice, where ESG reporting is increasingly recognised as a key governance mechanism. Similarly, the predominance of quantitative approaches, which are largely descriptive and exploratory in nature, indicates that the empirical foundations of the field remain underdeveloped, limiting the ability to assess the real impact of reporting practices on sustainability performance.

A central insight of this study concerns the misalignment between academic research and ongoing regulatory developments. While the literature continues to focus predominantly on voluntary disclosure practices, the global reporting landscape is progressively shifting towards mandatory and standardised frameworks. This transition is shaped by an evolving and heterogeneous regulatory landscape, where the introduction of mandatory requirements varies significantly across jurisdictions in terms of timing, scope, and entities involved. As a result, the limited attention to mandatory frameworks in the academic literature may partly reflect this institutional complexity. Such a transition has profound implications, as it redefines sustainability reporting from a primarily communicative and legitimacy-driven activity into a formalised governance tool. However, the extent to which this shift translates into substantive improvements in environmental and social performance remains uncertain.

The study aims to contribute to the literature in three main ways. First, it offers a comprehensive mapping of ESG

reporting research in extractive industries by integrating bibliometric, thematic, and content-based analyses. Second, it provides an interpretative framework of the field through a TCCM-informed lens, identifying key theoretical, contextual, and methodological imbalances. Third, and most importantly, it highlights a structural transition in the role of sustainability reporting, from a voluntary disclosure practice towards a governance mechanism potentially supporting sustainability transitions in resource-intensive sectors.

The findings carry several implications for future research. There is a clear need to develop more integrative theoretical approaches that move beyond traditional CSR-based frameworks and better reflect the complexity of ESG reporting. Expanding the geographical scope of analysis is essential to capture underrepresented regions and improve the global relevance of research. Greater attention should also be devoted to social and governance dimensions, which remain comparatively underdeveloped. Furthermore, advancing methodological approaches through quantitative and mixed-method designs and longitudinal analyses is crucial to strengthen empirical evidence. Finally, future studies should more explicitly investigate the effects of mandatory reporting frameworks, particularly in terms of their ability to drive substantive sustainability outcomes rather than mere compliance.

In addition, future research should investigate whether the growing institutionalisation of ESG reporting is accompanied by substantive improvements in sustainability performance or, conversely, may create conditions that increase the risk of symbolic disclosure and greenwashing. Although this issue has recently been explored in other sectors, particularly the energy industry (Esposito et al. 2025), it remains largely underexplored in extractive industries and represents a promising avenue for future research.

This study is subject to several limitations. The analysis is based on a single database, which, although comprehensive,

may not capture all relevant contributions. In addition, the review was limited to peer-reviewed journal articles published in English, excluding non-English publications, conference proceedings, and grey literature. While these criteria were adopted to ensure quality, consistency, and comparability across studies, they may have reduced the representation of contributions originating from underrepresented geographical regions and emerging research contexts. This methodological approach is consistent with the SPAR-4-SLR framework adopted in this study, which emphasises transparency, replicability, and methodological consistency through clearly defined search and selection criteria. Nevertheless, future reviews may complement this approach by incorporating additional databases and regional literature to further explore geographically specific perspectives. The content analysis involves an element of interpretative judgement, potentially introducing subjectivity. In addition, the rapidly evolving regulatory landscape implies that some findings may require updating as new standards and frameworks are implemented.

Despite these limitations, this study provides an integrative understanding of ESG reporting in extractive industries and highlights its ongoing transformation. Overall, the results suggest that sustainability reporting is evolving into a critical governance instrument for sustainability transitions in resource-intensive sectors, although its effectiveness in driving real environmental and social improvements remains an open and crucial research question.

Overall, the findings suggest that ESG reporting in extractive industries is not yet a fully developed governance system, but is progressively evolving in that direction under increasing regulatory and institutional pressure.

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