The Extractive Industries and Society 27 (2026) 101938

Contents lists available at ScienceDirect

The Extractive Industries and Society

journal homepage: www.elsevier.com/locate/exis

Rethinking environment, social and governance (ESG) in critical minerals extraction in the Democratic Republic of Congo

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ARTICLE INFO

Keywords:
Critical mineral governance
Extractive institutions
Global mineral value chains
Mining
Energy transitions

ABSTRACT

The global expansion of critical minerals supply chains has intensified scrutiny of environment, social and governance (ESG) performance, transforming access to international markets from resource-based to compliance-based. The Democratic Republic of Congo (DRC) holds strategic global importance as the world's leading producer of cobalt and a major producer of copper; however, persistent institutional and governance constraints undermine its geological advantage. Using a narrative review approach, this study synthesises academic literature, policy documents and investigative reports to examine the ESG landscape of the DRC and assess whether current governance practices enable participation in regulated, high-value minerals markets. Findings reveal that while the DRC's 2018 Mining Code expanded state participation and strengthened environmental and social obligations, enforcement remains weak, transparency is partial, and community consent mechanisms are procedural rather than rights-based. Comparative insights indicate that jurisdictions with legally protected environmental liabilities, continuous third-party monitoring, and enforceable community rights are better positioned to sustain market access and improve development outcomes. On this basis, the study develops an enhanced ESG governance framework for the DRC centred on four structural reforms: secured environmental liability, enforceable community rights, transparent fiscal accountability, and compliance-before-extraction sequencing. Without such reforms, the DRC risks remaining indispensable as a mineral producer while facing increasing constraints in accessing regulated, premium markets. With these, the DRC can be positioned as a compliant and competitive partner in global critical mineral value chains. These findings have implications for policies aimed at promoting the responsible and sustainable mining of critical minerals in Africa.

1. Introduction

Global efforts to shift from hydrocarbons to renewable energy systems are accelerating in response to climate change mitigation targets and energy security concerns (Abramova et al., 2023; Calderon et al., 2024). This transition depends on the large-scale deployment of low-carbon technologies, including solar photovoltaics, electric vehicles, battery storage, green hydrogen and geothermal systems (Bowell et al., 2020; Bridge and Faigen, 2022; Weng, 2025). Delivering these technologies requires a steady and expanding supply of minerals such as copper, lithium, nickel, cobalt, graphite and rare earth elements. Yet, the extraction and processing of these minerals are geographically concentrated, with a substantial share of reserves and production located in the global South, where institutional capacity, regulatory oversight and environmental governance are often weak (Boafo et al., 2024, 2025; Pitron, 2022). This spatial concentration has heightened supply chain vulnerabilities and intensified geopolitical competition over access to mineral resources. In response, governments, including those of the United States (US), the European Union (EU), the United Kingdom (UK), Canada, Australia and India, have formally designated these materials as *critical minerals* and adopted strategies aimed at securing resilient and diversified supply chains (Hine et al., 2023; Pitron, 2022; Weng, 2025). Alongside these policy shifts, Environmental, Social and Governance (ESG) principles have become

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https://doi.org/10.1016/j.exis.2026.101938
Received 30 November 2025; Received in revised form 20 April 2026; Accepted 21 April 2026
Available online 29 April 2026

increasingly prominent in debates about how mineral extraction can be aligned with sustainability, social equity and accountability objectives. ESG has conventionally been framed as a normative or voluntary governance framework, encouraging firms to integrate environmental protection, social responsibility and transparency into corporate decision-making (Eccles et al., 2020; OECD, 2018). More recently, however, ESG has begun to function as a compliance-oriented mechanism embedded in supply chain regulations, due diligence requirements, and market access conditions imposed by downstream actors and importing jurisdictions.

Demand for critical minerals continues to rise despite market uncertainties linked to geopolitical instability and trade tensions, particularly between the US and China (Boafo and Arthur Holmes, 2025; IEA, 2025). Between 2017 and 2022, global demand for lithium tripled, while cobalt and nickel increased by approximately 70% and 40%, respectively (IEA, 2023). Over the same period, the market values of critical minerals doubled, reaching an estimated $320 billion in 2022. Additionally, demand for lithium increased by 30% in 2024, surpassing the 10% yearly growth rate observed during the 2010s. Similarly, demand for rare earth elements, nickel, cobalt, and graphite increased by 6%- 8% in 2024 (IEA, 2025). Projections indicate that demand will more than double by 2030 and quadruple by 2050, with annual revenues expected to approach $400 billion (Holechek et al., 2022; IEA, 2022). These trends present significant economic opportunities for resource-rich countries in the global South, which collectively hold close to 60% of known reserves, largely concentrated in Africa, South America, Australia, and Southeast Asia (Kalantzakos, 2020; Nakanwagi, 2024).

Africa accounts for approximately 30% of global mineral reserves and occupies a strategic position within emerging critical mineral supply chains (Moreno-Brieva and Merino, 2020; Müller, 2023). Countries such as the Democratic Republic of Congo (DRC), Zimbabwe, Namibia, Madagascar, South Africa, Gabon, Ghana, Mozambique, and Mali hold substantial deposits of cobalt, lithium, graphite, and rare-earth elements (SandP Global Market Intelligence, 2023; US Geological Survey, 2022). Over the past two decades, China has become the dominant external actor in many of these contexts through sustained investment in mining operations, processing infrastructure, and associated logistics, particularly in the DRC and Zambia. In response, the US and EU have advanced new resource-diplomacy initiatives, including the *Inflation Reduction Act*, the *Critical Minerals Dominance Act,* and the *Critical Raw Materials Act,* aimed at diversifying supply chains and reducing strategic dependence on China. These geopolitical dynamics are accelerating exploration and extraction across the continent, often at a pace that outstrips regulatory and institutional capacity.

Despite these opportunities, the rapid expansion of critical mineral extraction in Africa risks reproducing long-standing patterns of resource dependency, social exclusion, and environmental degradation (Maconachie, 2016). Evidence points to widespread illegalities, environmental degradation, human rights abuses, corruption, forced evictions, conflicts, and loss of livelihoods in critical mineral-producing regions (Global Witness, 2023; Müller et al., 2023). In countries such as Zimbabwe and Namibia, large-scale lithium projects have been linked to biodiversity loss and ecosystem degradation. At the same time, documented cases of violence, displacement and human rights abuses near industrial mining sites further underscore the social risks associated with weak governance (Surma, 2023). These patterns highlight persistent failures to translate extractive activity into inclusive and sustainable development.

The DRC illustrates these challenges particularly starkly. The country supplies over 70% of the world's cobalt and is a major producer of copper, positioning it at the centre of the global energy transition (IEA, 2023). However, its extractive sector remains characterised by institutional fragility, corruption, poor labour conditions and severe environmental degradation (EITI, 2022; FPP, 2025; NRGI, 2021a). Although the 2018 Mining Code expanded state participation and strengthened environmental and social obligations, implementation and enforcement have remained uneven. Allegations of illicit payments and corruption, such as those involving Zijin Mining, a company seeking to acquire a lithium project that reportedly transferred $1.6 million to a consultancy firm linked to a senior political aide, underscore the ongoing governance risks associated with large-scale investments in critical minerals (Global Witness, 2023). Continental initiatives such as the *Africa Mining Vision* and global transparency mechanisms like the *Extractive Industries Transparency Initiative* (EITI) have sought to address these issues; however, their impact in the DRC has been limited by institutional constraints and fragmented enforcement (African Union, 2020; NRGI, 2021b; Weng, 2025).

Many studies have examined ESG performance, responsible sourcing initiatives and governance challenges in the DRC's mining sector. Much of this has focused on documenting environmental and social impacts, assessing development outcomes, or evaluating the effectiveness of voluntary standards and certification schemes (e.g., Mancini et al., 2021; Matanzima and Loginova, 2024; Mufungizi and Mpaka, 2025). While these contributions are important, they often treat ESG as either a descriptive indicator of governance quality or a voluntary corporate practice. Less attention has been paid to how ESG is increasingly operationalised as a compliance-based regime that conditions access to regulated, high-value mineral markets through supply-chain due diligence, traceability and verification requirements imposed by importing jurisdictions and downstream firms. This study reframes the context in the DRC, shifting from a predominantly normative or voluntary framework to a governance mechanism that increasingly functions as a gatekeeper for market participation. Specifically, we examine whether existing governance arrangements in the DRC can meet emerging ESG-linked compliance thresholds in global critical mineral supply chains. The article advances an analytical synthesis that links institutional design, enforcement capacity and community rights to market access outcomes.

Following the introduction, we conceptualise ESG within the context of extractive governance and outline the methods used for this review. We then analyse the position of the DRC within global critical minerals supply chains. Drawing on comparative evidence, the paper examines how different institutional arrangements shape ESG enforcement, compliance and market access, and discusses the implications for strengthening ESG governance in the DRC. We conclude by arguing that, given the complexity of the local context, global ESG standards cannot be applied wholesale but must be adapted to the DRC's institutional, political, and social conditions.

2. Conceptualising ESG in extractive governance

ESG has evolved from a corporate disclosure mechanism into a broader governance framework for integrating environmental protection, social responsibility and institutional accountability within resource-dependent economies (Eccles et al., 2020; OECD, 2023). It provides a basis through which investors, regulators, and policymakers evaluate the societal implications of extraction and align their decisions with international standards, including the Paris Agreement, the UN Guiding Principles on Business and Human Rights, and the Sustainable Development Goals. Within extractive contexts, ESG represents an attempt to connect mineral exploitation with longer-term developmental and ethical commitments rather than short-term revenue objectives. Its relevance in mineral-rich economies is grounded in longstanding debates in the political economy of natural resources, which emphasise that institutional quality, regulatory independence, and accountability mechanisms shape whether resource wealth generates broad-based development or entrenches inequality and environmental degradation (Auty, 2001; Mehlum et al., 2006). From this perspective, ESG can be understood as a governance response to structural weaknesses associated with the resource curse. It seeks to consolidate environmental safeguards, social protections and governance

controls within a single evaluative framework (Tienhaara, 2009).

Conceptually, this governance function can be situated within hybrid and polycentric governance arrangements, in which authority is distributed across states, firms, and transnational regulatory actors rather than residing exclusively within national regulatory institutions (Lemos and Agrawal, 2006; Ostrom, 2010). ESG therefore does not operate as a single regulatory instrument but as a multi-scalar governance mechanism embedded within global value chains, financial markets, and regulatory frameworks. This is particularly relevant in extractive sectors, where governance outcomes are shaped by the interaction between domestic institutional conditions and external compliance requirements.

Despite this governance positioning, ESG frameworks have been criticised for relying on voluntary commitments, self-reporting, and market discipline rather than on binding enforcement mechanisms, thereby limiting their ability to address social and environmental risks in practice (e.g., Frederiksen, 2018; Prno and Slocombe, 2012; Tienhaara, 2009). Empirical studies of extractive governance further show that ESG adoption is often shaped by investor risk considerations and reputational incentives, which do not consistently translate into improved social or environmental outcomes in contexts of weak regulatory capacity (Frederiksen et al., 2018; Jowitt et al., 2020). The framework encompasses three interlinked domains: environmental management, which concerns ecological integrity and alignment with climate and biodiversity objectives; social responsibility, including labour rights, community participation and human rights protections; and governance quality, which relates to regulatory integrity, disclosure standards and mechanisms for compliance enforcement. While this structure offers a common analytical language for assessing extractive practices, its application varies considerably across jurisdictions and sectors, particularly where institutional capacity is limited, and may therefore function as a signalling tool rather than an effective instrument of governance reform (Prno and Slocombe, 2012). In such contexts, voluntary ESG frameworks are frequently overshadowed by profit-oriented incentives. Under these conditions, transparency initiatives, disclosure requirements, and corporate reporting mechanisms rarely constrain behaviour in the absence of binding regulatory obligations, independent oversight and credible sanctions.

These limitations underscore the continued centrality of the state in environmental governance. Established environmental governance principles, including those reflected in UNEP frameworks, maintain that environmental protection remains a core state responsibility. ESG should therefore be understood as a complementary governance layer that interacts with, reinforces, or, in contexts of weak institutional capacity, partially compensates for deficiencies in domestic regulatory systems. In resource-constrained settings such as the DRC, this interaction produces hybrid governance arrangements in which state institutions, corporate actors, and transnational regulatory frameworks jointly shape compliance outcomes, albeit with uneven distribution of authority and accountability.

At the same time, ESG has undergone a regulatory expansion beyond its initial voluntary foundations. It has contributed to shifting analytical attention from firm-level reporting to the broader institutional conditions that shape extractive outcomes, including enforcement capacity, accountability structures and rights-based decision-making (Jowitt et al., 2020; OECD, 2018). More recently, it has been increasingly embedded within formal regulatory and market-access architecture governing participation in critical minerals supply chains. Instruments such as the EU Battery Regulation (European Union, 2023) and the EU Critical Raw Materials Act (European Union, 2024a) require auditable environmental data, traceable supply chains, and verifiable human rights compliance as conditions for entry into regulated markets rather than aspirational benchmarks. This expanding regulatory embedding of ESG is underpinned by multiple sources of institutional legitimacy. First, regulatory legitimacy arises from the incorporation of ESG requirements into binding legal instruments in major consumer jurisdictions. Second, market legitimacy derives from the role of ESG compliance in securing access to high-value supply chains and investment flows. Third, normative legitimacy is linked to its alignment with internationally recognised principles, including human rights, sustainability, and climate governance frameworks (Suchman, 1995; OECD, 2023). In the DRC, however, these sources of legitimacy are largely externally anchored and only partially embedded within domestic institutional structures, which limits the effectiveness and enforceability of ESG in practice. This regulatory turn has important implications for mineral-producing countries, as competitiveness increasingly depends on demonstrable ESG credibility verified through monitoring, traceability, and enforceable institutional practice (European Union, 2024b; OECD, 2023). Within this emerging regulatory economy, ESG operates as a gatekeeping mechanism that conditions access to high-value markets, placing jurisdictions with weak enforcement capacity at heightened risk of exclusion despite their strategic importance within global critical mineral supply chains.

3. Methodology: a narrative review approach

This study adopts a narrative review approach to synthesise and critically interpret literature on critical minerals, ESG and extractive governance in the DRC (Powell and Davies, 2016). Narrative reviews are appropriate when the evidence spans multiple disciplines, sources, and analytical traditions, and when the objective is interpretive synthesis rather than statistical aggregation. This enables the integration of diverse evidence to examine how ESG is framed and applied within extractive governance contexts, and how variations in institutional capacity shape its implementation and governance outcomes. The review followed a structured process comprising four stages (Fig. 1): defining the analytical scope, identifying relevant literature, analysing thematic documents, and conducting a narrative synthesis. Literature was drawn from academic databases, including Google Scholar, Scopus, ScienceDirect, and Web of Science, and supplemented by institutional and investigative reports from multilateral bodies, regulatory bodies, and civil society groups. Search terms combined keywords related to 'critical minerals in Africa,' 'ESG in the DRC,' 'responsible mining,' 'sustainable mining,' and 'the geopolitics of critical minerals.' These were iteratively refined using Boolean operators (i.e., AND, OR, and NOT) to ensure coverage of recent and policy-relevant scholarship (Ragin, 1994).

The retrieved documents were screened for relevance to the review's analytical focus, resulting in a final corpus of approximately 110 sources. Documents were analysed using thematic document analysis (Bowen, 2009), which identified recurring patterns, governance tensions, and analytical framings. These were consolidated into a set of overarching themes relating to institutional capacity, regulatory enforcement, market incentives, and community-level impacts. This allowed comparison across sources and enabled the identification of consistent patterns and points of divergence. Evidence was compared across sources to assess consistency and divergence in empirical claims, strengthening the robustness of the synthesis.

Although narrative reviews lack defined inclusion and exclusion criteria (Smith and Duncan, 2022), this was mitigated through cross-source comparison and by prioritising grounded and policy-relevant evidence. This supports a structured interpretive synthesis, allowing the study to draw connections between diverse bodies of literature while maintaining analytical coherence.

4. Positioning the DRC in the global mineral value chain

The DRC occupies a strategically essential yet structurally marginal position within global critical mineral value chains. It is one of the world's largest sources of cobalt and a major producer of copper and other transition minerals (Fig. 2). However, its role is almost entirely confined to upstream extraction, as domestic refining and processing capacity remains limited. Minerals are therefore exported in raw or

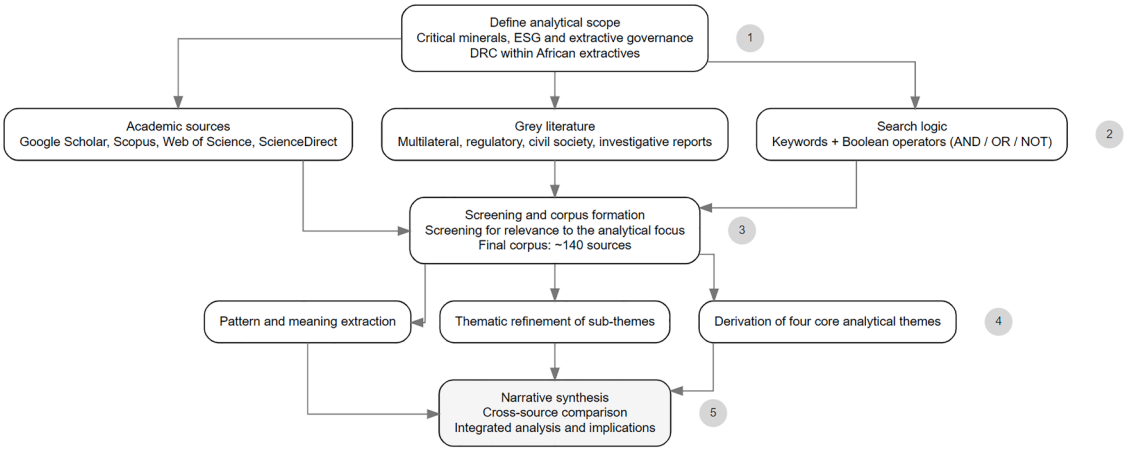

Fig. 1. Flow chart of the narrative review process.

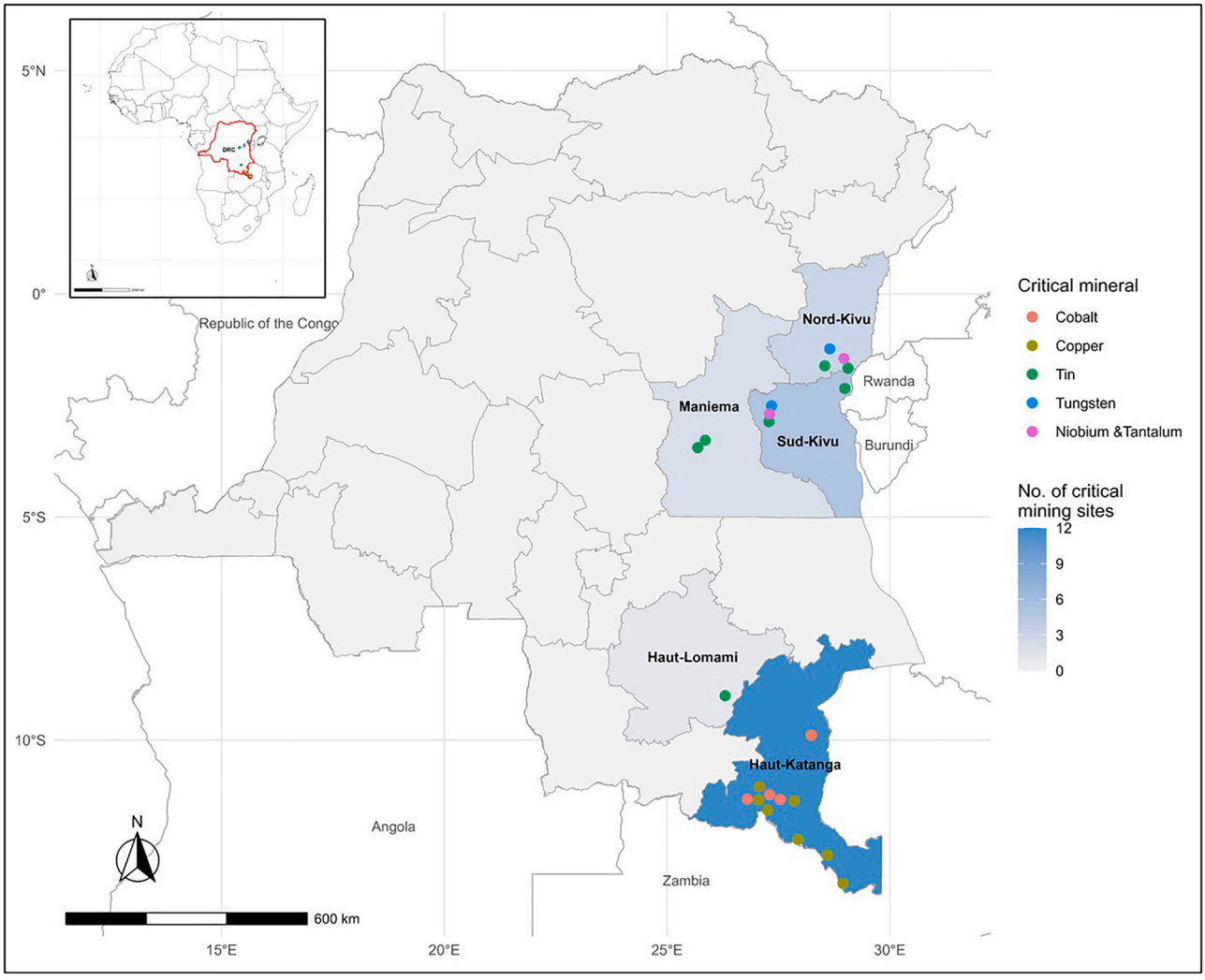

Fig. 2. A map of the DRC, showing critical minerals deposits (Source: Authors' construct with data from Banerjee (2015)).

semi-processed form, with the country capturing only a small share of downstream value and associated rents (Ouedraogo and Kilolo, 2024). This pattern reflects the prevailing global organisation of critical mineral supply chains, in which midstream and downstream activities such as refining, precursor production and battery-component manufacturing are concentrated outside Africa, particularly in China, which controls a substantial share of global cobalt and lithium refining capacity and key segments of the battery industry (Boafo, 2025; IEA, 2023). Because pricing power, technological capabilities and standards-setting authority are largely embedded within these processing stages, the external concentration of refining capacity significantly weakens the DRC's bargaining position and entrenches structural dependence on foreign

firms for capital, technology, and market access (Pitron, 2022).

Recent policy discourse within the DRC reflects growing recognition of the need to expand domestic value addition and reduce dependence on raw mineral exports. The most visible initiative is the 2022 Cooperation Framework between the DRC, Zambia and the United States, which aims to support the development of a regional electric-vehicle battery value chain (Boafo, 2025; Byamungu, 2023). This initiative aligns with broader regional ambitions articulated in the Africa Mining Vision and the African Continental Free Trade Area Industrialisation agenda, both of which emphasise local processing and beneficiation as pathways to structural transformation. Available evidence, however, suggests that these commitments remain largely aspirational. Refining, precursor production and component manufacturing continue to be located predominantly outside the DRC, and there is little indication that the core configuration of global value chains has shifted in ways that materially enhance domestic value capture (Cao et al., 2024; IEA, 2023; Weng, 2025).

Geopolitical competition over critical minerals has intensified these dynamics rather than fundamentally altering them. Supply-diversification initiatives by the EU, alongside sustained engagement by China and the US, reflect heightened external interest in securing access to the DRC's mineral reserves (Beuter et al., 2024; IEA, 2023). This was made explicit at the 2026 US-led Critical Minerals Ministerial, convened in part to counter China's downstream dominance, at which the DRC participated and signed cooperation agreements that embed access to its mineral resources within US- and allied-led strategic frameworks (U.S. Department of State, 2026). However, such initiatives have largely focused on securing upstream supply rather than fostering downstream industrial upgrading within the DRC. Structural constraints, including limited infrastructure, high energy costs, regulatory uncertainty and the dominance of foreign firms operating under long-term contractual agreements, continue to restrict entry into midstream and downstream segments. As a result, the global distribution of processing capacity exerts a more decisive influence over the DRC's position in mineral value chains than recent diplomatic or policy initiatives.

These structural features have direct implications for governance, sustainability and ESG performance. The concentration of value-adding activities outside the DRC limits the state's leverage over pricing, technology transfer and compliance standards. At the same time, foreign dominance in mining operations constrains the scope for effective contractual renegotiation and regulatory oversight. ESG requirements and traceability obligations are largely defined and enforced downstream, yet compliance costs and social and environmental risks are disproportionately borne upstream, where institutional capacity is weakest. This asymmetry is particularly pronounced where industrial supply chains intersect with artisanal and small-scale mining, further complicating monitoring and enforcement (Hilson, 2020). Recent work highlights that the marginalisation of local interests in critical mineral frontiers constitutes a supply-chain risk, as failures in securing social licence can generate conflict, delays, and disruptions that affect investor confidence and supply stability (Sefa-Nyarko, 2026, 2025; Vanclay and Hanna, 2019). Within this asymmetric governance setting, ESG frameworks are often framed in terms of supply-chain sustainability and investor risk management, but their effectiveness depends on the extent to which extraction retains social legitimacy among affected communities. Where geopolitical competition and external supply-security priorities dominate, local interests risk being marginalised, increasing the likelihood of community opposition and production disruption. Social licence thus functions as a critical governance mechanism linking local-level legitimacy to broader supply-chain stability, reinforcing the argument that ESG compliance without enforceable community rights and meaningful participation remains fragile. Situating the DRC within this global value-chain structure is therefore essential for understanding why governance challenges persist and why enhanced ESG frameworks must address not only domestic regulation but also the structural distribution of power, responsibility and value along critical mineral supply chains.

5. ESG vulnerabilities in the DRC's critical minerals sector

In this section, we examine how the conceptual commitments established in Section 4 translate into practice within the DRC's critical minerals sector and identify the specific environmental, social, and governance vulnerabilities that shape extractive outcomes.

5.1. Environment

5.1.1. Environmental risk intensity of critical minerals extraction

Critical minerals extraction is highly intensive in terms of waste and pollution. Life-cycle assessments reveal that, for certain critical minerals, such as cobalt and copper, the extracted rock and tailings can amount to hundreds of tonnes per tonne of refined metal (ETC, 2023; Nassar et al., 2022). Tailings dams, for instance, fail at rates 10 to 100 times higher than those of conventional water-retaining dams, with a higher incidence in jurisdictions with weaker regulatory oversight (Azam and Li, 2010; Lin et al., 2022; Rico et al., 2008). In the DRC's copper-cobalt belt, elevated soil and human biomonitoring studies document cobalt and other metal levels significantly above background levels, particularly near mining operations (Banza et al., 2009; Cheyns et al., 2014) and small-scale mining further intensifies environmental risks using heavy chemicals and land disturbance (Arthur-Holmes and Busia, 2022; Hilson and McQuilken, 2014). It is estimated that artisanal mining accounts for about 1220 tonnes of mercury emissions annually, making ASM the largest source of anthropogenic mercury globally (United Nations Environment Programme (UNEP), 2019). Tyukavina et al. (2018) also demonstrate that mining-driven deforestation is a significant contributor to forest loss in parts of the Central African region. Collectively, these data show that environmental risk in the DRC is structural, spatially concentrated, and insufficiently monitored beyond the operational life of a mine.

5.1.2. Environmental governance framework and enforcement gaps

African mining legislation has expanded formal environmental safeguards, including mandatory Environmental Impact Assessments (EIAs), Environmental Management Plans (EMPs), and financial guarantees for post-closure rehabilitation. For example, South Africa operationalises closure financing through the National Environmental Management Act and associated Financial Provisioning Regulations, which require ring-fenced rehabilitation guarantees (Humby, 2016; Limpitlaw, 2004). Ghana mandates EIAs prior to mineral licensing under the Minerals and Mining Act, while Zambia administers environmental permitting through the Environmental Management Act No.12 (2011) (Phiri et al., 2019; Yao et al., 2025). These cases show that environmental governance failures in the region stem less from legislative absence than from weaknesses in enforcement capacity, regulatory autonomy and institutional design. Across the literature, breakdowns recur most frequently at three regulatory control points, including environmental monitoring, compliance verification, and enforcement of rehabilitation liability. In the DRC, mine inspections are intermittent, environmental audit reports are rarely disclosed, and regulatory institutions lack both fiscal autonomy and sanctioning capacity (Global Witness, 2023; NRGI, 2021b). Rehabilitation guarantees, where applied, are often neither inflation-indexed, independently verified, nor adjusted to reflect actual closure-cost trajectories, resulting in systematic under-provisioning of liabilities (World Bank, 2022). Even in comparatively mature jurisdictions, closure financing gaps persist. In South Africa, the best-developed mine closure regime on the continent still exhibits chronic shortfalls between projected rehabilitation costs and secured financial guarantees, allowing liabilities to be transferred to the state and affected communities (Humby, 2016; Koatlhai, 2025).

Structural transparency and disclosure gaps amplify these

enforcement weaknesses. Regional assessments by the World Bank show that mine-closure information is rarely centralised or publicly accessible, and that financial assurance records and environmental audit reports are inconsistently disclosed across countries (Wakenge et al., 2021; World Bank, 2022). Monitoring systems, when present, are often paper-based, fragmented, and non-standardised, which undermines independent verification and cross-site comparability. These failures are institutional rather than technical. Environmental degradation persists not because mitigation instruments are unavailable, but because compliance systems lack digitisation, auditability, escrow-protected financing, and enforceable penalty regimes. Table 1 illustrates the differences between these systemic governance gaps and enforcement models in stronger jurisdictions.

5.1.3. *From compliance discourse to enforceable environmental accountability*

High-integrity mining systems control environmental liability through enforceable financial safeguards rather than voluntary commitments. Where closure costs are independently calculated, inflation-adjusted and legally ring-fenced, post-operation environmental debt is significantly reduced. Where guarantees are self-estimated, unsecured, or politically negotiable, liabilities are off-balance-sheet and ultimately transferred to governments or communities (Crous and Marais, 2025; NRGI, 2021b; World Bank, 2022). Robust environmental governance also depends on continuous, transparent and verifiable monitoring rather than episodic self-reporting. Effective systems treat environmental data as public infrastructure, supported by digital emissions tracking, satellite monitoring, and accessible ecological registries (ICMM–UNEP–PRI, 2020; Morrison and Adams, 2025). Without these systems, environmental harm becomes difficult to measure, validate, or enforce, delaying liability recognition and weakening regulatory credibility (Global Witness, 2023; World Bank, 2022). A further differentiator is whether risk-reduction technologies are legally mandated or corporately discretionary. Instruments such as tailings dewatering, leakage detection, and low-emission processing reduce ecological risk when tied to permitting conditions, rather than being adopted voluntarily (Jiskani et al., 2023).

In the DRC, these safeguards remain inconsistently institutionalised. Mine closure funds are often under-capitalised, rarely ring-fenced, and infrequently recalibrated to reflect rising rehabilitation costs, creating predictable liability gaps (NRGI, 2021b). Environmental baselines are fragmented, and post-impact monitoring data are not systematically archived or publicly audited, limiting independent verification of soil, water, and tailings contamination (Global Witness, 2023; World Bank, 2022). Adoption of environmental technology remains non-binding, leaving risk mitigation uneven and non-enforceable (NRGI, 2021b). These conditions shift environmental governance from regulated accountability toward negotiated compliance, increasing long-term ecological and fiscal exposure.

The consequences now extend beyond environmental harm to market access. Critical minerals governance is rapidly transitioning toward legally verifiable supply chain compliance. Regulations, including the EU Critical Raw Materials Act (European Union, 2024a) and the EU Battery Regulation (European Union, 2023), require auditable, site-level environmental data, emissions tracking, and traceable compliance. These frameworks do not assess policy intent. They assess proof of compliance. For the DRC, sustaining competitiveness will therefore depend less on mineral abundance and more on embedding enforceable closure liabilities, verifiable monitoring systems, and mandated environmental safeguards. Without these, mineral reserves may secure extraction, but not long-term access to regulated supply chains.

5.2. *Social*

5.2.1. *Integrating social sustainability into DRC's critical minerals sector*

Social sustainability is central to responsible resource governance. It involves not only environmental protection and economic contribution but also ethical engagement, equitable benefit sharing and the protection of human rights (Khamis et al., 2023; Lami and Mecca, 2021; Wang and Ke, 2024). In the DRC, however, mining has long been embedded within conflict-affected political economies, particularly in the eastern provinces, where extractive activity has been associated with forced displacement, militarisation of resource control, land dispossession and the erosion of customary authority (Autesserre, 2010; Cuvelier et al., 2014; Verweijen and Wakenge, 2015). Geenen (2014) and Wakenge et al. (2021) also document how mining expansion in North and South Kivu has contributed to the reconfiguration of local power relations, the fragmentation of community governance structures and the deepening of social vulnerability in already fragile post-conflict settings. These dynamics illustrate that social impacts in the DRC are not incidental side effects of extraction but are structurally produced through the interaction of weak state authority, armed actors and transnational mineral demand.

The rapid expansion of cobalt and copper extraction under the global

Table 1
Environmental enforcement gaps in critical mineral governance (comparative view).

Governance safeguard	Evidence from strong jurisdictions	Outcomes in comparator contexts	Current condition in the DRC	References
Mine closure and rehabilitation financial assurance	Canada and Australia require fully costed closure plans and ring-fenced financial assurance (bonds, LOCs, trust funds).	Reduces orphaned mines and ensures funds are available in the event of operator default.	The DRC's Mining Code includes closure obligations, but implementation is weak, and financial assurance is inconsistently enforced.	IGF/IISD, 2021; World Bank, 2022; NRGI, 2021b
Environmental monitoring and public disclosure	Chile and the EU require ongoing environmental monitoring and public online disclosure of selected air, water and emissions data.	Public disclosure enables independent scrutiny and strengthens compliance.	Monitoring is irregular, fragmented and rarely published; a consolidated reporting portal is absent.	IGF/IISD, 2021; NRGI, 2021a
Tailings risk governance	The Global Industry Standard on Tailings Management (GISTM) requires independent review boards and third-party audits.	Countries that apply GISTM show greater transparency and reduced failure risk.	Enforcement is inconsistent; oversight capacity is limited, and audit follow-up is weak.	ICMM–UNEP–PRI, 2020; Crous and Marais, 2025; NRGI, 2021a
ASM pollution control	Under the Minamata Convention, Ghana and Peru have National Action Plans to reduce mercury in artisanal gold mining.	NAPs create structured pathways to reduce emissions and improve monitoring.	ASM mercury use is widespread and largely unregulated, with low enforcement capacity.	UNEP, 2019; Minamata Convention Secretariat, 2017; NRGI, 2021a; Boafo et al., 2019
Regulator independence and enforcement capacity	High-performing sectors (e.g., Chile, Botswana) separate policy, regulation, and commercial roles, maintaining rule-based regulators.	These models show more consistent enforcement and lower political interference.	The DRC scores 36/100 on the RGI; overlapping mandates and weak autonomy reduce enforcement credibility.	NRGI, 2021b

Source: Compiled by Authors.

energy transition has intensified these pressures. Investigations consistently report child labour, hazardous working conditions, forced evictions and the marginalisation of artisanal mining communities in both industrial and informal supply chains (Amnesty International, 2016). In eastern DRC, mining-related displacement and community conflict are closely linked to broader patterns of governance failure, in which local populations bear the social costs of extraction while remaining excluded from decision-making and benefit-sharing (Deberdt and Billon, 2021). Therefore, social sustainability in the DRC cannot be treated as a technical governance add-on, but as a response to historically entrenched patterns of exclusion and violence associated with mineral extraction. Global normative frameworks such as the EITI and the International Council on Mining and Metals (ICMM) provide important reference points, but their effectiveness depends on local enforceability and political context. In the DRC, social sustainability cannot rely solely on imported templates; it requires re-contextualisation through domestic institutions that recognise customary tenure, community rights, and the legacies of conflict that shape contemporary extractive frontiers. Without such grounding, ESG and responsible mining agendas risk reproducing technocratic solutions that overlook the lived realities of mining-affected populations.

Against this backdrop, three interlinked governance frameworks increasingly shape contemporary social sustainability discourse: the Social License to Operate (SLO), Corporate Social Responsibility (CSR), and supply chain due diligence and traceability. Together, they reflect successive attempts to institutionalise social legitimacy, moving from local consent to corporate accountability and finally to international verification. In the DRC, however, these frameworks remain fragmented and weakly embedded, limiting their capacity to translate social principles into enforceable protections for mining-affected communities.

5.2.2. *The social license to operate; institutionalising community legitimacy*

SLO represents an informal form of societal consent that determines whether extractive projects maintain legitimacy over time. The concept was initially articulated by Joyce and Thomson (2000) and later elaborated by Thomson and Boutilier (2011) to capture the idea that legal compliance alone is insufficient to secure stable operating conditions in resource extraction. Since then, SLO has become widely embedded in mining governance discourse and corporate risk management frameworks, reflecting recognition that community opposition can generate significant operational, financial and reputational risks (Mitchell, 2019; 2023). However, despite its widespread uptake, it does not constitute a legally codified right or a standardised regulatory instrument, but rather a socially constructed and continually renegotiated form of legitimacy. Recent critical scholarship emphasises that the concept is conceptually ambiguous and politically contested, lacking clear legal status, consistent operational definition and agreed standards of measurement, which affords firms considerable discretion in how legitimacy is claimed and demonstrated (Bice and Moffat, 2014; Jijelava and Vanclay, 2017; Owen and Kemp, 2013). Rather than functioning as a stable governance framework, it is increasingly understood as a dynamic process shaped by shifting community expectations, corporate strategies and regulatory environments. In practice, it may operate less as a mechanism of community empowerment and more as a managerial tool for risk mitigation, particularly where engagement processes remain firmly controlled and weakly embedded in public institutions. Scholars caution that this can depoliticise conflict by framing opposition as a communication failure rather than as an expression of more profound distributive and procedural injustices.

Despite these limitations, SLO remains analytically valuable for understanding the conditions under which extractive projects gain or lose social legitimacy. Vanclay and Hanna (2019) demonstrate that sustained community acceptance depends not on episodic consultation but on procedural fairness, credible participation, benefit sharing and institutional accountability (Vanclay and Hanna, 2019). Where engagement is continuous, transparent and legally anchored, social licence outcomes are more durable; where participation is symbolic, conflict and project disruption are more likely. This insight is increasingly reflected in industry risk assessments, which identify community relations as a principal non-technical risk across global mining operations (Mitchell, 2019; 2023). In high-governance jurisdictions such as Canada and Australia, elements of the SLO have become partially institutionalised through early consultation requirements, impact-benefit agreements and judicial avenues for community redress, even though the concept itself remains formally informal (Bice et al., 2017; CSIRO, 2024). In Chile, social license is reinforced by strong environmental institutions and an active civil society participation. These cases illustrate that while the SLO cannot substitute for regulation, its durability depends on the extent to which community legitimacy is embedded within enforceable governance structures.

In the DRC, by contrast, community consent remains largely procedural and externally managed. Consultation processes are often non-iterative, weakly inclusive and insufficiently grounded in local social and cultural contexts, functioning more as corporate disclosure exercises than mechanisms of shared decision-making (Jean-François, 2014; Verweijen et al., 2022). The consequences are evident in persistent mining-related conflicts shaped by elite capture, weak institutional oversight and the exclusion of local communities from land and resource governance (Berman et al., 2017; Bezzola et al., 2022; Christensen, 2019; Engels, 2016; Hanai, 2021). In such settings, the SLO cannot be treated as a stand-alone framework of legitimacy but must be understood as contingent on the credibility of underlying governance arrangements. Where participation lacks legal grounding and institutional protection, community acceptance remains fragile and easily reversible. Reframing the SLO, therefore, requires embedding community legitimacy within formal regulatory processes, so that engagement is not discretionary but is anchored in rights-based participation, independent facilitation, and enforceable grievance mechanisms. This situates social licence within institutional accountability rather than solely in voluntary corporate practice (ICMM, 2024; OECD, 2025).

5.2.3. *Re-conceptualising corporate social responsibility (CSR) in DRC*

CSR represents a formalised channel through which companies express social obligations beyond profit maximisation (Carroll, 1991). Globally, CSR has evolved from a philanthropic gesture to a strategic instrument linking social legitimacy with long-term corporate value (Baron, 2001; McWilliams and Siegel, 2001). In much of sub-Saharan Africa, however, CSR practice remains externally driven and primarily reputational (Bice, 2014; Frynas, 2005). In the DRC, corporate initiatives often prioritise visibility over impact, failing to address the structural needs of mining-affected communities or to align with local development priorities (Bice, 2014; Frynas, 2005; Hilson et al., 2019; Ndong, 2023). This stands in marked contrast to countries such as Australia, where CSR is not only more institutionally embedded but also strategically aligned with broader regulatory, reputational, and sustainability imperatives. Although CSR in Australia remains formally voluntary, it is strongly incentivised through industry-wide frameworks—most notably the Minerals Council of Australia's (MCA) Enduring Value Framework, which is aligned with the ICMM Principles. Moreover, CSR practices are increasingly integrated into ESG reporting regimes, particularly for companies listed on the Australian Securities Exchange (ASX), which mandates transparency through sustainability disclosures under its Corporate Governance Principles.

Frynas (2005) provides a foundational critique of CSR in Africa, arguing that corporate initiatives in the region rarely extend beyond narrow philanthropic gestures, thereby reinforcing a persistent disconnect between community expectations and corporate engagement. Similarly, Hilson et al. (2019) identify a fundamental structural misalignment between the externally constructed logics of CSR programmes and the lived realities of mining-impacted communities, often resulting in mistrust, conflict, and developmental stagnation.

The intensifying global demand for critical minerals affords Africa a

renewed opportunity to redefine the contours of CSR. In the DRC, reform requires state-led coordination and more substantial regulatory alignment. National CSR strategies, grounded in performance benchmarks, fiscal incentives, and mandatory disclosures, could align corporate investments with provincial development priorities and measurable community outcomes. Equally important is the co-development of CSR projects with affected populations. Recognising communities as decision-making partners rather than passive beneficiaries would embed social accountability into corporate operations and reduce conflict risk. For the DRC, the shift from philanthropic to rights-based and co-governed CSR is central to sustainable mining legitimacy.

5.2.4. *Due diligence, traceability and social accountability in supply chains*

Social legitimacy increasingly extends beyond the mine site to encompass entire supply chains. International frameworks now require that mineral sourcing meet verifiable human rights and labour standards (OECD, 2018; IEA, 2025). The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas defines due diligence as a continuous process of identifying, preventing and mitigating adverse social and environmental impacts. It serves as a central framework for ethical risk management and underpins responsible business conduct in high-risk sectors such as mining. Due diligence typically encompasses a wide array of governance domains, including human rights, labour relations, environmental protection, anti-corruption, consumer interests, and disclosure (OECD, 2018). Within this framework, risk-based due diligence, which prioritises the most severe and probable adverse impacts, has been strongly advocated (OECD, 2023). This approach acknowledges the practical limitations of identifying and addressing all possible risks, thereby enhancing the feasibility and effectiveness of due diligence implementation. Nevertheless, the growing emphasis on environmental and human rights due diligence within mineral supply chains has exposed significant information gaps regarding the provenance of minerals and the conditions under which they are extracted, processed, and traded (Burritt and Schaltegger, 2014). These informational asymmetries highlight the importance of traceability, defined as the ability to track a product's origin, geographic trajectory, chain of custody, and physical transformation throughout the supply chain (IEA, 2025).

In the DRC, weak institutional oversight and informal trade networks have long obscured the provenance of minerals, facilitating exploitative labour practices and illicit financial flows (Amnesty International, 2016; Burritt and Schaltegger, 2014). Implementing risk-based due diligence would enable regulators and buyers to prioritise the most severe risks, enhance transparency, and build confidence in the DRC-sourced materials (OECD, 2023). Also, embedding traceability within legal and institutional frameworks would align the DRC with emerging compliance regimes such as the EU Battery Regulation (2023), the Conflict Minerals Regulation (2017), and the Corporate Sustainability Due Diligence Directive (2024). The challenge is therefore dual: building national verification systems capable of tracing mineral flows and ensuring that the data generated through these systems translates into social protection, fair labour practices, and community benefits. This requires coordinated engagement among state institutions, companies, and civil society. By operationalising traceability as a tool for social justice rather than a technical compliance metric, the DRC could transform its role from a high-risk supplier to a trusted source in regulated global markets.

5.3. *Governance*

5.3.1. *From legislative ambition to enforcement failure*

Governance is central to determining whether the DRC's wealth of critical minerals supports inclusive development or perpetuates long-standing patterns of extraction without structural transformation. Resource governance refers to the rules, institutions, and decision-making systems that determine licensing, revenue management, oversight and public accountability (Amoakoh, 2024). Despite being among the world's most mineral-endowed countries, the DRC has struggled to convert this endowment into sustained development outcomes, reflecting a widely documented manifestation of the "resource curse" (Auty, 2001; Ross, 2012). The global energy transition intensifies this challenge. Critical minerals are no longer conventional export commodities; they are now strategic, securitised and geopolitically contested (Boafo et al., 2024; Kalantzakos, 2020). As a result, governance weaknesses now generate domestic economic and social costs and heighten exposure to supply chain disruptions, trade restrictions and compliance risks within global markets.

Comparative experience demonstrates that resource wealth contributes to national development only when governance frameworks ensure institutional separation, regulatory independence, fiscal transparency, and long-term planning. For example, Norway's petroleum governance model clearly separates policy making, regulatory oversight, and commercial operations, supported by a ring-fenced sovereign wealth fund that stabilises long-term national revenues (Holden, 2013; Thurber et al., 2011). Botswana achieved developmental returns from diamonds through strong legislative oversight, controlled revenue management and disciplined state participation in contracting (Hillbom, 2014; Jeke and Sanderson, 2025). Chile, a major copper exporter, combined predictable mining legislation with counter-cyclical fiscal buffers to stabilise revenue volatility (Frankel, 2012). These cases illustrate a consistent principle: institutional robustness, rather than resource abundance alone, determines developmental outcomes. The DRC illustrates the inverse condition. Despite having a strategic mineral advantage, the governance of its extractive sector remains characterised by opacity in licensing, political interference, contract renegotiations, corruption risk, and weak enforcement capacity (Global Witness, 2017; NRGI, 2021b). The 2018 DRC Mining Code introduced stronger royalty provisions, state participation rights, and incentives for industrial processing. However, statutory reform has not changed enforcement realities. A persistent implementation gap separates legal design from regulatory practice, driven by overlapping institutional mandates, limited technical oversight, political bargaining in concession allocation, and weak judicial insulation (Global Witness, 2017; NRGI, 2021b).

The Resource Governance Index consistently ranks the DRC among the lowest-performing extractive economies globally and in Africa, particularly with respect to contract transparency, regulatory oversight, and enforcement of environmental and social obligations (NRGI, 2017, 2021b). Although governance scores for the mining sector improved marginally between 2017 and 2021, these gains have not moved the DRC out of the lowest performance tiers, nor have they translated into materially stronger governance outcomes (Fig. 3). In absolute terms, the mining-sector score in the 2021 Resource Governance Index was 36 out of 100, placing it in the *poor category*. This points to a deeper structural problem: reforms have expanded the formal architecture of mining governance without establishing credible enforcement capacity.

5.3.2. *Transparency and accountability without enforceability*

Transparency reforms have generally improved nominal disclosure in the DRC, but they remain partially implemented. Revenues are published through the EITI, yet reporting gaps persist in contract disclosure, beneficial ownership transparency, and sub-national revenue transfers (EITI, 2022). Unlike jurisdictions where contract publication is mandatory, standardised and enforceable, disclosure in the DRC remains selective and non-systematised, reducing public accountability and constraining independent verification of mineral value flows (EITI, 2022; NRGI, 2021b). Transparency without enforceability has therefore become symbolic rather than structural. This distinction is particularly consequential in critical mineral value chains, where purchasers now need to demonstrate compliance with supply chain governance legislation, including the EU Critical Raw Materials Act (European Union, 2024a), the EU Battery Regulation (European Union, 2023) and the Corporate Sustainability Due Diligence Directive (European Union, 2024b), all of which demand traceability, risk disclosure, and audited

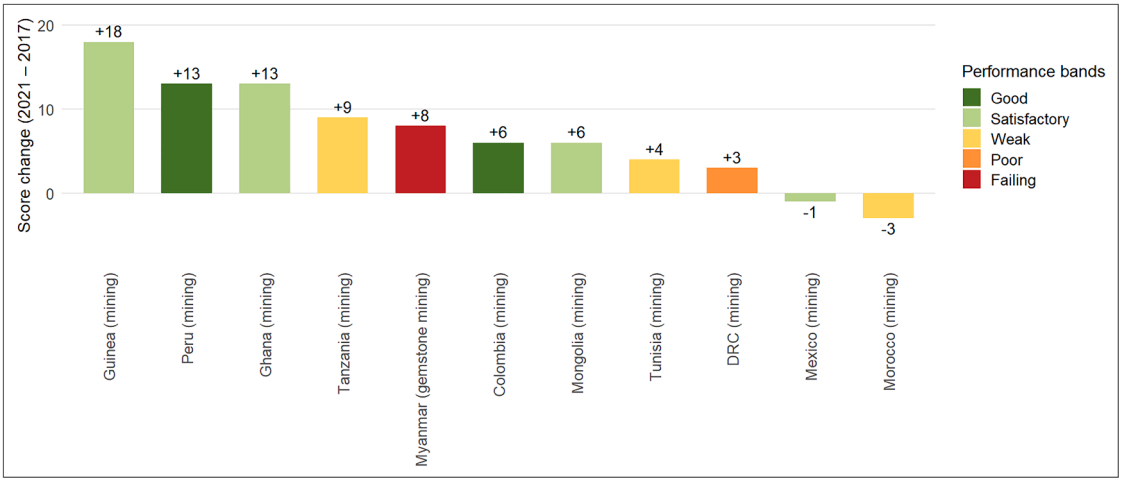

Fig. 3. Changes in Resource Governance Index scores for mining sectors between 2017 and 2021. Positive values indicate improvement in governance performance over the period, while negative values indicate decline. Source: Authors' reproduction based on data from the Natural Resource Governance Institute, Resource Governance Index (2017; 2021a).

verification of source integrity.

A similar pattern is visible in accountability mechanisms. Formal oversight institutions exist, but their deterrent effect is limited by political bargaining, discretionary enforcement and operational constraints that prevent consistent application of mining regulations (Wakenge et al., 2021). Sovacool (2019) and De Haan and Geenen (2016) document how systemic corruption, institutional fragmentation and weak sanctioning mechanisms undermine the credibility of regulatory oversight in the DRC's extractive sector. In contexts where extraction rents influence political financing, regulatory agencies face pressures that weaken independent sanctioning authority, particularly in strategic minerals such as cobalt (Global Witness, 2017; Sovacool, 2019). As a result, accountability becomes episodic rather than systematic. Comparative evidence suggests that accountability improves only when audit institutions are insulated from executive influence and when corruption risk triggers automatic, non-negotiable penalties rather than discretionary investigations (Corrales and Penfold, 2011; Ross, 2015). These safeguards are not yet embedded within the DRC's governance framework.

5.3.3. Distributional equity, community consent and institutional redesign

Equity in revenue distribution in the DRC remains a structural weakness. Under the 2018 Mining Code (Art 242), a proportion of mineral royalties is legally earmarked for redistribution to provinces and local entities: 25% of royalties should be transferred to provincial governments and 15% to decentralised territorial entities. These transfers are intended to finance regional infrastructure and development in mining-affected areas. In practice, however, the EITI (2022) report reveals persistent gaps between statutory requirements and actual transfers, characterised by significant delays, partial disbursements, and limited traceability of funds. Surma (2023) argues that mineral extraction continues to generate social conflict in the DRC because of mining-affected communities bearing environmental and social costs without receiving a proportionate developmental return. Mineral revenues continue to accumulate at the national level, while mining provinces report weak public reinvestment, inadequate infrastructure and persistent disputes over whether extraction produces meaningful local returns (EITI, 2022). Comparative resource governance reveals that an inequitable revenue distribution not only generates dissatisfaction but also undermines state legitimacy, heightens political risk, and disrupts extraction through episodic community resistance and disputes over benefit claims (Owusu and Amoakoh, 2025; Provenzano and Bull, 2021). In countries such as Canada and Australia, sub-national revenue-sharing arrangements distribute mineral royalties through transparent, rules-based fiscal frameworks. These systems stabilise public finances, reduce volatility and embed regional development objectives within formal fiscal architecture, thereby strengthening the governance foundations of extraction (Qiao and Shah, 2023; Söderholm and Svahn, 2015). By contrast, the legislated revenue-sharing framework in the DRC remains inconsistently implemented, insufficiently audited and vulnerable to political discretion (NRGI, 2021b). Without enforceable guarantees for subnational allocations, extraction will continue to generate conflict rather than alignment with development.

Justice and community consent represent an additional governance constraint. Although Free, Prior and Informed Consent (FPIC) has become internationally recognised as a baseline for responsible extraction, its practical implementation in the DRC remains limited and non-binding (Surma, 2023). FPP (2025) reports that FPIC processes are frequently procedural, fragmented or conducted without enforceable community rights. In areas where FPIC has legal force, such as the Philippines under the Indigenous Peoples' Rights Act, enforceability has altered negotiation dynamics, strengthened benefit-sharing arrangements and formalised community participation in concession decisions (Barelli, 2012). The absence of comparable legal enforceability in the DRC means community consent functions as a consultative expectation rather than a rights-based requirement.

Three structural risks now converge on the DRC. First, critical minerals are no longer ordinary commodities; they are strategic inputs within competing industrial policy frameworks, intensifying geopolitical sensitivity. Second, ESG compliance is increasingly a market-entry condition, shaped by legally binding requirements in major consumer jurisdictions. Third, extraction timelines are accelerating while governance capacity remains comparatively static. This produces a governance timing mismatch, in which extraction expands more rapidly than institutions can regulate, verify, or enforce. The DRC, therefore, faces a strategic choice. It may continue its licensing-forward governance model, maximise short-term extraction, or adopt institutional redesign that strengthens contract transparency, establishes independent auditing, secures royalty traceability, protects sub-national revenue allocations, formalises community consent mechanisms, and embeds enforceable compliance verification. The latter pathway is slower to construct, but the former has become untenable under contemporary supply chain governance and due diligence regimes.

6. Towards an enhanced ESG framework for the DRC

The analysis presented in this review indicates that the future positioning of the DRC's critical minerals sector is shaped not only by

resource endowment but increasingly by credible, auditable ESG performance. Global supply chains for cobalt, lithium and copper are undergoing regulatory reconfiguration, with market access increasingly conditioned on traceability, due diligence verification and environmental integrity requirements introduced in major consumer jurisdictions, notably the EU and the US. These developments reflect a shift away from predominantly voluntary sustainability commitments towards compliance-oriented governance arrangements that increasingly influence participation in higher-value segments of critical mineral markets. At the same time, the growing reliance on traceability, verification and certification frameworks warrants scrutiny. Scholarship on global value chains and extractive governance has shown that such instruments often function less as mechanisms of substantive sustainability and more as procedural compliance devices that privilege the regulatory priorities, risk perceptions and commercial interests of consuming jurisdictions (LeBaron and Lister, 2015; Ponte and Gibbon, 2005; Power, 1997; Sinclair and Coe, 2024). Such schemes have been criticised for functioning as market-access signals that secure downstream compliance while shifting adjustment costs and monitoring burdens to producing countries, often without addressing underlying power asymmetries, labour conditions, or environmental harm. Traceability and verification should therefore be understood as governance tools whose effectiveness depends on their embedding within enforceable institutional frameworks and locally accountable regulatory systems, rather than as inherently transformative solutions.

Across the environmental, social, and governance dimensions, the evidence shows that ESG commitments in the DRC remain largely procedural. Statutory reforms have expanded formal environmental and social obligations; however, enforcement capacity, transparency, and accountability remain constrained. As a result, compliance is uneven and often difficult to verify. This points to the limitations of declaratory ESG commitments and suggests the need for governance arrangements that prioritise demonstrable and enforceable compliance. Participation in regulated critical mineral supply chains increasingly depends on producing countries' ability to demonstrate environmental integrity, social legitimacy, and institutional credibility through transparent, auditable mechanisms rather than policy alignment alone.

For the DRC, this implies developing a coherent set of institutional foundations and verification processes that engage with emerging international expectations while remaining responsive to domestic governance constraints. Reform therefore needs to move beyond procedural improvement towards institutional guarantees; transparency should evolve from selective disclosure towards automatic and auditable reporting; accountability should shift from discretionary enforcement towards rule-bound sanctioning; revenue distribution mechanisms require stronger protection of subnational allocations to mitigate centralised capture; community consent arrangements need to transition from a consultative practice towards enforceable rights; and environmental and social compliance mechanisms should move from firm-led self-reporting towards independent, third-party verification embedded within regulatory oversight. Fig. 4 summarises these structural requirements, outlining the key institutional inputs, verification mechanisms and market-access criteria that together define an enhanced ESG framework for the DRC.

Four priority areas are identified: (1) environmental liability independently assessed, financially secured and insulated from discretionary renegotiation; (2) community engagement shifting from consultative processes to enforceable rights, including legally binding approaches to FPIC; (3) transparency advancing from partial disclosure to traceable and auditable evidence covering contracts, beneficial ownership and subnational revenue transfers; (4) licensing contingent on demonstrated compliance capacity, reversing the prevailing model in which extraction precedes monitoring frameworks. These elements outline a shift from permissive, extraction-oriented governance to a system anchored in accountability, verifiable compliance and rights-based participation.

7. Conclusion

This review has examined the governance of critical minerals in the DRC through the lens of ESG, situating the country's extractive sector within rapidly evolving global supply-chain regimes. While the DRC occupies a strategically central position in the production of cobalt and other transition minerals, the analysis shows that geological endowment alone is increasingly insufficient to secure sustained participation in regulated, high-value markets. The credibility, auditability and enforceability of ESG performance within global value chains increasingly shape competitiveness. The study reveals a persistent gap between formal ESG commitments and substantive governance outcomes in the DRC. Although statutory reforms have expanded environmental and social obligations, implementation remains uneven and enforcement

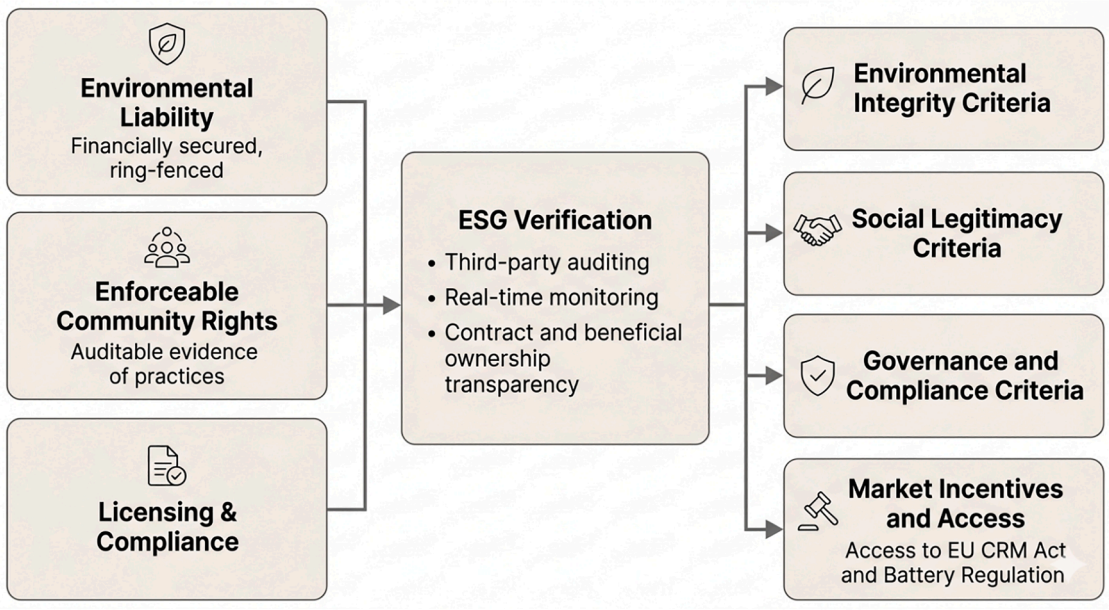

Fig. 4. Structural ESG reform pathways for the DRC's critical minerals sector.

capacity constrained. Transparency and accountability mechanisms often operate procedurally rather than structurally, limiting their ability to constrain extractive practices or deliver meaningful social and environmental protection. These challenges are not unique to the DRC; they reflect broader structural limitations of ESG governance in the extractives sector, particularly where voluntary standards intersect with weak domestic institutions and uneven external regulatory reach.

Reframing ESG as a compliance-oriented regime linked to market access rather than a purely normative or voluntary governance framework contributes to debates on critical mineral governance and sustainable resource extraction. It shows that traceability, certification, and verification mechanisms, while increasingly central to supply-chain governance, are not inherently transformative and may reproduce existing power asymmetries unless embedded within enforceable, locally accountable institutional arrangements. For the DRC, the transition from declaratory ESG commitments to demonstrable compliance therefore represents both a governance challenge and a strategic opportunity within the global energy transition. Future research could extend this analysis by examining how emerging regulatory instruments, including the EU Battery Regulation and related due diligence regimes, are operationalised in producer countries and how compliance costs and benefits are distributed across actors. Comparative studies across critical mineral-producing jurisdictions could further clarify how variations in institutional capacity, regulatory design and international oversight shape ESG outcomes. Greater attention is also needed to the social dimensions of ESG, including community rights, cultural heritage and labour conditions, to ensure that governance reforms associated with the energy transition do not reproduce the inequalities they seek to address.

Data availability

No data was used for the research described in the paper.

CRediT authorship contribution statement

Alex Owusu Amoakoh: Writing – review & editing, Writing – original draft. **James Boafo:** Writing – review & editing, Writing – original draft, Conceptualization. **Jacob Obodai:** Writing – review & editing, Writing – original draft. **Senyo Dotsey:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Acknowledgement

We thank the handling editor and two anonymous reviewers for their constructive feedback and comments, which helped improve the quality of the paper.

References

Abramova, I.O., Sharova, A.Y., 2023. Geostrategic risks in the transition to green energies (Using the Example of Africa). Geol. Ore Depos. 65 (5), 449–462. https://doi.org/10.1134/S1075701523050021.

African Union, 2020. Africa mining vision. https://au.int/en/ti/amv/about.

Amoakoh, A.O. (2024). Who governs when governance fails? Institutional complexity and substituted authority in Ghana's peatlands. Available at SSRN: 10.2139/ssrn.6023954.

Amnesty International, 2016. This is What We Die For: Human Rights Abuses in the Democratic Republic of Congo Power the Global Trade in Cobalt. Amnesty International, London. https://www.amnesty.org/en/documents/afr62/3183/2016/en/.

Arthur-Holmes, F., Busia, K.A., 2022. Safety concerns and occupational health hazards of women in artisanal and small-scale mining in Ghana. Extr. Ind. Soc. 10, 101079. https://doi.org/10.1016/j.exis.2022.101079.

Autesserre, S., 2010. The Trouble With the Congo: Local violence and the Failure of International Peacebuilding. Cambridge University Press.

Auty, R.M. (Ed.), 2001. Resource Abundance and Economic Development. Oxford University Press.

Azam, S., Li, Q., 2010. Tailings dam failures: a review of the last one hundred years. Geotech. News 28 (4), 50–53.

Banerjee, S.G., Romo, Z., McMahon, G., Toledano, P., Robinson, P., Pérez Arroyo, I., 2015. The Power of the Mine: A Transformative Opportunity for Sub-Saharan Africa. Directions in Development–Energy and Mining. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/21402.

Baron, D.P., 2001. Private politics, corporate social responsibility, and integrated strategy. J. Econ. Manag. Strat. 10 (1), 7–45. https://doi.org/10.1111/j.1430-9134.2001.00007.x.

Banza, C.L.N., Nawrot, T.S., Haufroid, V., Decrée, S., De Putter, T., Smolders, E., Kabyla, B.I., Luboya, O.N., Ilunga, A.N., Mutombo, A.M., Nemery, B., 2009. High human exposure to cobalt and other metals in Katanga, a mining area of the Democratic Republic of Congo. Environ. Res. 109 (6), 745–752. https://doi.org/10.1016/j.envres.2009.04.012.

Barelli, M., 2012. Free, prior and informed consent in the aftermath of the UN Declaration on the Rights of Indigenous Peoples: developments and challenges ahead. Int. J. Hum. Rights 16 (1), 1–24. https://doi.org/10.1080/13642987.2011.597746.

S&P Global Market Intelligence, 2023. Globally significant discoveries position Africa as potential major lithium hub. https://www.spglobal.com/market-intelligence/en/news-insights/research/spotlight-on-growing-african-lithium-supply.

Berman, N., Couttenier, M., Rohner, D., Thoenig, M., 2017. This mine is mine! how minerals fuel conflicts in Africa. Am. Econ. Rev. 107 (6), 1564–1610. https://doi.org/10.1257/aer.20150774.

Beuter, P., Bhuee, R., Gabadadze, L., Gnanguênon, A., Hofmeyr, J., 2024. Mapping Africa's Green Mineral Partnerships. Report. Africa Policy Research Institute. https://afripoli.org/mapping-africas-green-mineral-partnerships.

Bezzola, S., Günther, I., Brugger, F., Lefoll, E., 2022. CSR and local conflicts in African mining communities. World Dev. 158, 105968. https://doi.org/10.1016/j.worlddev.2022.105968.

Bice, S., 2014. What gives you a social licence? An exploration of the social licence to operate in the Australian mining industry. Resources 3, 62–80. https://doi.org/10.3390/resources3010062.

Bice, S., Brueckner, M., Pforr, C., 2017. Putting social licence to operate on the map: a social, actuarial and political risk and licensing model (SAP Model). Resour. Policy 53, 46–55. https://doi.org/10.1016/j.resourpol.2017.05.011.

Bice, S., Moffat, K., 2014. Social licence to operate and impact assessment. Impact Assess. Proj. Apprais. 32 (4), 257–262. https://doi.org/10.1080/14615517.2014.950122.

Boafo, J., Paalo, S.A., Dotsey, S., 2019. Illicit Chinese small-scale mining in Ghana: beyond institutional weakness? Sustainability 11 (21), 5943. https://doi.org/10.3390/su11215943.

Boafo, J., Dotsey, S., Spencer, R., 2025. Energy transition diplomacy: the EU's pursuit of Africa's critical minerals for renewable energy at whose expense? Energy Res. Soc. Sci. 127, 104213. https://doi.org/10.1016/j.erss.2025.104213.

Boafo, J., Nkrumah, P., Obodai, J., Stemn, E., 2024. The race for critical minerals in Africa; a blessing or another resource curse? Resour. Policy 93, 105046. https://doi.org/10.1016/j.resourpol.2024.105046.

Boafo, J., Arthur-Holmes, F., 2025. Sustainability transition paradox: emerging dimensions of illegal artisanal and small-scale mining of critical minerals in Africa. Resour. Policy Vol. 108 (September 2025), 105673. https://doi.org/10.1016/j.resourpol.2025.105673.

Boafo, J., 2025. The geopolitical race for critical minerals in Africa. The Rising Significance of Critical Minerals in Africa: Potential for Cooperation. Indian Council of World Affairs, Sapru House, New Delhi. https://icwa.in/pdfs/TheRisingSignificanceAfricaWeb.pdf.

Bowell, R.J., Lagos, L., de los Hoyos, C.R., Declercq, J., 2020. Classification and characteristics of natural lithium resources. Elements 16 (4), 259–264. https://doi.org/10.2138/gselements.16.4.259.

Bowen, G.A., 2009. Document analysis as a qualitative research method. Qual. Res. J. 9 (2), 27–40. https://doi.org/10.3316/QRJ0902027.

Bridge, G., Faigen, E., 2022. Towards the lithium-ion battery production network: thinking beyond mineral supply chains. Energy Res. Soc. Sci. 89, 1–19. https://doi.org/10.1016/j.erss.2022.102659.

Burritt, R., Schaltegger, S., 2014. Accounting towards sustainability in production and supply chains. Br. Account. Rev. 46 (4), 327–343. https://doi.org/10.1016/j.bar.2014.10.001.

Byamungu, C.G.N., 2023. The U.S.–Zambia–DRC Agreement on EV Batteries Production: What Comes Next? CSIS, 6 March 2023. Available at: https://www.csis.org/analysis/us-zambia-drc-agreement-ev-batteries-production-what-comes-next.

Calderon, J.L., Smith, N.M., Bazilian, M.D., Holley, E., 2024. Critical mineral demand estimates for low-carbon technologies: what do they tell us and how can they evolve? Renew. Sustain. Energy Rev. 189, 113938. https://doi.org/10.1016/j.rser.2023.113938.

Cao, X., Sharmina, M., Cuéllar-Franca, R.M., 2024. Sourcing cobalt in the Democratic Republic of the Congo for a responsible net-zero transition: incentives, risks and stakeholders. Resour. Policy 95, 105149. https://doi.org/10.1016/j.resourpol.2024.105149.

Carroll, A.B., 1991. The pyramid of corporate social responsibility: toward the moral management of organizational stakeholders. Bus. Horiz. 34 (4), 39–48.

Ragin, C.C., 1994. Introduction to qualitative comparative analysis. In: Janoski, T., Hicks, A.M. (Eds.), The Comparative Political Economy of the Welfare State. Cambridge University Press, Cambridge, pp. 299–319. https://doi.org/10.1017/cbo9781139174053.013.

Cheyns, K., Nkulu, C.B.L., Ngombe, L.K., Asosa, J.N., Haufroid, V., De Putter, T., Nawrot, T., Kimpanga, C.M., Numbi, O.L., Ilunga, B.K., Nemery, B., 2014. Pathways of human exposure to cobalt in Katanga, a mining area of the DR Congo. Sci. Total Environ. 490, 313–321. https://doi.org/10.1016/j.scitotenv.2014.05.014.

Christensen, D., 2019. Concession stands: how mining investments incite protest in Africa. Int. Organ. 73 (1), 65–101. https://doi.org/10.1017/S0020818318000413.

Crous, C., Marais, L., 2025. Transparency of reporting on tailings storage facilities by the six largest members of the International Council on Mining and Metals. Resour. Policy 111, 105784. https://doi.org/10.1016/j.resourpol.2025.105784.

Corrales, J., Penfold-Becerra, M., 2011. Dragon in the tropics: Hugo Chávez and the Political Economy of Revolution in Venezuela. Brookings Institution Press, Washington DC.

CSIRO, 2024. Social licence to operate. https://www.csiro.au/en/work-with-us/industries/mining-resources/Social-and-environmental-performance/Social-licence-to-operate.

Cuvelier, J., Van Bockstael, S., Vlassenroot, K., Iguma, C., 2014. Analyzing the Impact of the Dodd-Frank Act on Congolese Livelihoods. Social Science Research Council, Conflict Prevention and Peace Forum, New York.

Deberdt, R., Le Billon, P., 2021. Conflict minerals and battery materials supply chains: a mapping review of responsible sourcing initiatives. Extr. Ind. Soc. 8 (4), 100935. https://doi.org/10.1016/j.exis.2021.100935.

De Haan, J., Geenen, S., 2016. Mining cooperatives in eastern drc: the interplay between historical power relations and formal institutions. Extr. Ind. Soc. 3, 823–831. https://doi.org/10.1016/j.exis.2016.05.003.

Eccles, R.G., Lee, L.E., Stroehle, J.C., 2020. The social origins of ESG: an analysis of Innovest and KLD. Organ. Environ. 33 (4), 575–596. https://doi.org/10.1177/10860266198889.

Engels, B., 2016. Mining conflicts in sub-Saharan Africa: actors and repertoires of contention (No. 2). GLOCON Working Paper. https://hdl.handle.net/10419/199095.

ETC, 2023. Material and resource requirements for the energy transition: producing and using materials for a net-zero future. URL: https://www.energy-transitions.org/publications/material-and-resource-energy-transition/.

EITI, 2022. Democratic republic of congo: 2022 eiti report. Extr. Ind. Transpar. Initiat. URL: https://eiti.org/documents/democratic-republic-congo-2022-eiti-report.

European Union, 2023. Regulation (eu) 2023/1542 concerning batteries and waste batteries. Off. J. Eur. Union. URL: http://data.europa.eu/eli/reg/2023/1542/oj.

European Union, 2024a. Regulation (eu) 2024/1252 establishing a framework for ensuring a secure and sustainable supply of critical raw materials. Off. J. Eur. Union. URL: https://eur-lex.europa.eu/eli/reg/2024/1252/oj.

European Union, 2024b. Directive (eu) 2024/1760 on corporate sustainability due diligence. Off. J. Eur. Union. URL: http://data.europa.eu/eli/dir/2024/1760/oj.

FPP, 2025. Between a rock and a hard place: human rights impacts in the drc's mining sector. Briefing Paper, Forest Peoples Programme. URL: https://www.forestpeoples.org/fileadmin/uploads/fpp/Publications/2025_Between_A_Rock_DRC/Between_a_rock_and_a_hard_place.pdf.

Frankel, J.A., 2012. The natural resource curse: a survey of diagnoses and some prescriptions. In: Arezki, R., Pattillo, C., Quintyn, M., Zhu, M. (Eds.), Commodity Price Volatility and Inclusive Growth in Low-Income Countries. International Monetary Fund, Washington, DC, pp. 17–57. CID Working Paper No. 233; HKS Research Working Paper No. RWP12-014.

Fredericksen, T., 2018. Corporate social responsibility, risk and development in the mining sector. Resour. Policy 59, 495–505. https://doi.org/10.1016/j.resourpol.2018.09.004.

Frynas, G., 2005. The false developmental promise of corporate social responsibility: evidence from multinational corporations. Int. Aff. 81 (3), 581–598. https://doi.org/10.1111/j.1468-2346.2005.00470.x.

Geenen, S., 2014. Dispossession, displacement and resistance: artisanal miners in a gold concession in South-Kivu, Democratic Republic of Congo. Resour. Policy 40, 90–99. https://doi.org/10.1016/j.resourpol.2013.03.004.

Global Witness, 2023. A rush for lithium in Africa risks fuelling corruption and failing citizens. https://www.globalwitness.org/en/campaigns/natural-resource-governance/lithium-rush-africa/.

Global Witness, 2017. Regime Cash Machine. Global Witness, London. https://globalwitness.org/en/campaigns/oil-gas-and-mining/regime-cash-machine/.

Hanai, K., 2021. Conflict minerals regulation and mechanism changes in the DR Congo. Resour. Policy 74, 102394. https://doi.org/10.1016/j.resourpol.2021.102394.

Hillbom, E., 2014. Cattle, diamonds and institutions: main drivers of Botswana's economic development, 1850 to present. J. Int. Dev. 26 (2), 155–176. https://doi.org/10.1002/jid.2957.

Hilson, G., 2020. Formalization bubbles': a blueprint for sustainable artisanal and small-scale mining (ASM) in sub-Saharan Africa. Extr. Ind. Soc. 7 (4), 1624–1638. https://doi.org/10.1016/j.exis.2020.11.001.

Hilson, G., McQuilken, J., 2014. Four decades of support for artisanal and small-scale mining in sub-Saharan Africa: a critical review. Extr. Ind. Soc. 1 (1), 104–118. https://doi.org/10.1016/j.exis.2014.01.002.

Hilson, A., Hilson, G., Dauda, S., 2019. Corporate social responsibility at African mines: linking the past to the present. J. Environ. Manage. 241, 340–352. https://doi.org/10.1016/j.jenvman.2019.03.121.

Hine, A., Gibson, C., Mayes, R., 2023. Critical minerals: rethinking extractivism? Aust. Geogr. 54 (3), 233–250. https://doi.org/10.1080/00049182.2023.2210733.

Holden, S., 2013. Avoiding the resource curse the case Norway. Energy Policy 63, 870–876. https://doi.org/10.1016/j.enpol.2013.09.010.

Holechek, J.L., Geli, H.M.E., Sawalhah, M.N., Valdez, R., 2022. A global assessment: can renewable energy replace fossil fuels by 2050? Sustainability 14, 4792. https://doi.org/10.3390/su14084792, 2022.

Humby, T., 2016. Mine Closure and Rehabilitation in South Africa: Moving beyond denial? Centre for Environmental Rights, Johannesburg. Available at: https://cer.org.za/wp-content/uploads/2016/05/Prof-T-Humby-5.5.2016.pdf?.

ICMM–UNEP–PRI, 2020. Global Industry Standard On Tailings Management. International Council on Mining and Metals (ICMM), United Nations Environment Programme (UNEP) & Principles for Responsible Investment (PRI), London. https://globaltailingsreview.org/global-industry-standard/.

ICMM, 2024. Mining Principles: performance expectations. https://www.icmm.com/website/publications/pdfs/mining-principles/mining-principles.pdf?cb=111036.

IGF/IISD, 2021. Environmental Management in the Mining Sector: A Guidance Document for Governments. International Institute for Sustainable Development (IISD) & Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development, Winnipeg. https://www.iisd.org/system/files/2021-05/igf-guidance-governments-environmental-management-mining-en.pdf.

International Energy Agency (IEA), 2022. World Energy Outlook 2022. IEA, Paris. https://www.iea.org/reports/world-energy-outlook-2022. License: CC BY 4.0 (report); CC BY NC SA 4.0 (Annex A.

International Energy Agency (IEA), 2023. Critical Minerals Market Review 2023. IEA, Paris. https://www.iea.org/reports/critical-minerals-market-review-2023. License: CC BY 4.0.

International Energy Agency, 2025. The Role of Traceability in Critical Mineral Supply Chains. IEA. https://www.iea.org/reports/the-role-of-traceability-in-critical-mineral-supply-chains.

Jean-François, M., Giacomo, L., Petros, G.S., John, U., 2014. Mineral resources and conflicts in DRC: a case of ecological fallacy? Oxf. Econ. Pap. 66 (3), 721–749. https://doi.org/10.1093/oep/gpt037. July 2014.

Jeke, L., Sanderson, A., 2025. Industrial value addition, credit growth and economic growth in Botswana. Int. J. Econ. Financ. Issues 15, 242. https://doi.org/10.32479/ijefi.20025.

Jiskani, I.M., Zhou, W., Hosseini, S., Wang, Z.M., 2023. Mining 4.0 and climate neutrality: a unified and reliable decision system for safe, intelligent, and green & climate-smart mining. J. Clean. Prod. 410 (2023), 137313. https://doi.org/10.1016/j.jclepro.2023.137313.

Jijelava, D., Vanclay, F., 2017. Legitimacy, credibility and trust as the key components of a social licence to operate: an analysis of BP's projects in Georgia. J. Clean. Prod. 140, 1077–1086. https://doi.org/10.1016/j.jclepro.2016.10.070.

Jowitt, S.M., Mudd, G.M., Thompson, J.F., 2020. Future availability of non-renewable metal resources and the influence of environmental, social, and governance conflicts on metal production. Commun. Earth Environ. 1 (1), 13. https://doi.org/10.1038/s43247-020-0011-0.

Joyce, S., Thomson, I., 2000. Earning a social license to operate: social acceptability and resource development in Latin America. Can. Min. Metall. Bull. 93, 49–53. https://oncommonground.ca/wp-content/downloads/license.htm.

Kalantzakos, S., 2020. The race for critical minerals in an era of geopolitical realignments. Int. Spect. 55, 1–16. https://doi.org/10.1080/03932729.2020.1786926.

Khamis, I., Elshater, A., Afifi, S., Baher, M., 2023. Residents' responses to social interactions and social sustainability in gated communities of the Greater Cairo Region. HBRC J. 19 (1), 543–562. https://doi.org/10.1080/16874048.2023.2287772.

Koatlhai, O., 2025. Co-designing the future: integrating social transition and compliance for sustainable mine closures. J. South Afr. Inst. Min. Met. 125 (4), 187–192. https://doi.org/10.17159/2411-9717/794/2025.

Lami, I.M., Mecca, B., 2021. Assessing social sustainability for achieving sustainable architecture. Sustainability 13 (1), 142. https://doi.org/10.3390/su13010142.

LeBaron, G., Lister, J., 2015. Benchmarking global supply chains: the power of the 'ethical audit'regime. Rev. Int. Stud. 41 (5), 905–924. https://doi.org/10.1017/S0260210515000388.

Lemos, M.C., Agrawal, A., 2006. Environmental governance. Annu. Rev. Environ. Resour. 31 (2006), 297–325. https://doi.org/10.1146/annurev.energy.31.042605.135621.

Limpitlaw, D., 2004. Mine Closure As a Framework For Sustainable Development. University of the Witwatersrand, South Africa. https://www.mineclosure.net/elibrary/mine-closure-as-a-framework-for-sustainable-development.

Lin, S.Q., Wang, G.J., Liu, W.L., Zhao, B., Shen, Y.M., Wang, M.L., Li, X.S., 2022. Regional distribution and causes of global mine tailings dam failures. Metals 12 (6), 905. https://doi.org/10.3390/met12060905.

Maconachie, R., 2016. The extractive industries, mineral sector reform and post-conflict reconstruction in developing countries. Extr. Ind. Soc. 3 (2), 313–315. https://doi.org/10.1016/j.exis.2016.03.004.

Mancini, L., Eslava, N.A., Traverso, M., Mathieux, F., 2021. Assessing impacts of responsible sourcing initiatives for cobalt: insights from a case study. Resour. Policy 71, 102015. https://doi.org/10.1016/j.resourpol.2021.102015.

Matanzima, J., Loginova, J., 2024. Sociocultural risks of resource extraction for the low-carbon energy transition: evidence from the Global South. Extr. Ind. Soc. 18, 101478. https://doi.org/10.1016/j.exis.2024.101478.

McWilliams, A., Siegel, D., 2001. Corporate social responsibility: a theory of the firm perspective. Acad. Manag. Rev. 26 (1), 117–127. https://doi.org/10.5465/amr.2001.4011987.

Mehlum, H., Moene, K., Torvik, R., 2006. Cursed by resources or institutions? World Econ. 29 (8), 1117–1131. https://doi.org/10.1111/j.1467-9701.2006.00808.x.
Minamata Convention Secretariat, 2017. Guidance For Developing a National Action Plan For Artisanal and Small-Scale Gold Mining. United Nations Environment Programme, Geneva. https://minamataconvention.org/sites/default/files/documents/forms_and_guidance_document/ASGM_guidance_e_2017.pdf.
Mitchell, P., 2019. Top 10 Business Risks and Opportunities For Mining and Metals in 2020. EYGM Limited. https://www.cubility.com.au/wp-content/uploads/2020/01/Top-10-Business-Risks-and-Opportunities-%E2%80%93-2020.pdf.
Mitchell, P., 2023. Top 10 Business Risks and Opportunities For Mining and Metals in 2024. EYGM Limited. https://www.ey.com/content/dam/ey-unified-site/ey-com/en-gl/insights/energy-resources/documents/ey-top-10-business-risks-and-opportunities-for-mining-and-metals-in-2024-final.pdf.
Moreno-Brieva, F., Merino, C., 2020. African international trade in the global value chain of lithium batteries. Mitig. Adapt. Strateg. Glob. Change 25 (6), 1031–1052. https://doi.org/10.1007/s11027-020-09911-8.
Morrison, K.F., Adams, A., 2025. Tailings management: collaborative initiatives for positive change. GeoStrata Mag. Arch. 29 (3), 64–71. https://doi.org/10.1061/geosek.000063.
Mufungizi, I., Mpaka, Y.W., 2025. Transforming resource wealth into sustainable futures: ESG integration in the Democratic Republic of Congo's mining sector. Extr. Ind. Soc. 24, 101719. https://doi.org/10.1016/j.exis.2025.101719.
Müller, M., 2023. The 'new geopolitics' of mineral supply chains: a window of opportunity for African countries. S. Afr. J. Int. Aff. 30 (2), 177–203. https://doi.org/10.1080/10220461.2023.2226108.
Müller, M., Schulze, M., Schöneich, S., 2023. The energy transition and green mineral value chains: challenges and opportunities for Africa and Latin America. S. Afr. J. Int. Aff. 30 (2), 169–175. https://doi.org/10.1080/10220461.2023.2230957.
Nakanwagi, S., 2024. Critical Minerals, Sustainability, and the Energy Transition in the Global South: A Justice Perspective. Hart Publishing, Oxford. ISBN: 9781509976720. Available at https://www.torrossa.com/it/resources/an/5868722.
Nassar, N.T., Lederer, G.W., Brainard, J.L., Padilla, A.J., Lessard, J.D., 2022. Rock-to-metal ratio: a foundational metric for understanding mine wastes. Environ. Sci. Technol. 56 (10), 6710–6721. https://doi.org/10.1021/acs.est.1c07875.
Ndong, A.G.N., 2023. Challenges of CSR in Sub-Saharan Africa: clarifying the gaps between the regulations and human rights issues. Int. J. Corp. Soc. Responsib. 8 (2). https://doi.org/10.1186/s40991-023-00079-3.
NRGI, 2017. Resource Governance Index 2017. Natural Resource Governance Institute. Available at: https://resourcegovernance.org/sites/default/files/documents/2017-resource-governance-index.pdf.
NRGI, 2021a. 2021 Resource Governance Index. Natural Resource Governance Institute, New York. https://resourcegovernanceindex.org/publications-data.
NRGI, 2021b. 2021 Resource Governance Index: democratic Republic of Congo (Mining). https://resourcegovernance.org/publications/2021-resource-governance-index-democratic-republic-congo-mining.
OECD, 2018. OECD Due Diligence Guidance For Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, 3rd ed. OECD Publishing https://www.oecd.org/content/dam/oecd/en/publications/reports/2016/04/oecd-due-diligence-guidance-for-responsible-supply-chains-of-minerals-from-conflict-affected-and-high-risk-areas_g1g65996/9789264252479-en.pdf.
OECD, 2023. OECD Guidelines for Multinational Enterprises On Responsible Business Conduct. OECD Publishing. https://doi.org/10.1787/81f92357-en.
OECD, 2025. Mining Regions and Cities in Northern Ontario, Canada, OECD Rural Studies. OECD Publishing, Paris. https://doi.org/10.1787/d3676159-en.
Ostrom, E., 2010. Beyond markets and states: polycentric governance of complex economic systems. Am. Econ. Rev. 100 (3), 641–672. https://doi.org/10.1257/aer.100.3.641.
Ouedraogo, N.S., Kilolo, J.M.M., 2024. Africa's critical minerals can power the global low-carbon transition. Prog. Energy 6 (3), 033004. https://doi.org/10.1088/2516-1083/ad46da.
Owen, J.R., Kemp, D., 2013. Social licence and mining: a critical perspective. Resour. policy 38 (1), 29–35. https://doi.org/10.1016/j.resourpol.2012.06.016.
Owusu, E., Amoakoh, A.O., 2025. Conflict frames associated with state compulsory acquisition of lands in barekese, ghana. Front. Sustain. Resour. Manag. 4. https://doi.org/10.3389/fsrma.2025.1543829.
Phiri, D., Morgenroth, J., Xu, C., 2019. Long-term land cover change in Zambia: an assessment of driving factors. Sci. Total Environ. 697, 134206. https://doi.org/10.1016/j.scitotenv.2019.134206.
Pitron, G., 2022. The geopolitics of the rare-metals race. Wash Q. 45 (1), 135–150. https://doi.org/10.1080/0163660X.2022.2059146.
Powell, A., Davies, H., 2016. Doctors and Managers: a Narrative Literature Review. Nuffield Trust, London. Supplementary reportAvailable at: https://www.nuffieldtrust.org.uk/sites/default/files/2017-01/doctors-managers-lit-review-web-final.pdf.
Ponte, S., Gibbon, P., 2005. Quality standards, conventions and the governance of global value chains. Econ. Soc. 34 (1), 1–31. https://doi.org/10.1080/0308514042000329315.
Power, M., 1997. The Audit Society: Rituals of Verification. OUP, Oxford.
Provenzano, S., Bull, H., 2021. The local economic impact of mineral mining in africa: evidence from four decades of satellite imagery. https://doi.org/10.48550/arXiv.2111.05783.
Prno, J., Slocombe, D.S., 2012. Exploring the origins of 'social license to operate'in the mining sector: perspectives from governance and sustainability theories. Resour. Policy 37 (3), 346–357. https://doi.org/10.1016/j.resourpol.2012.04.002.
Qiao, B., Shah, A., 2023. Revenue sharing from natural resources: principles and practices. In: Shah, A. (Ed.), Taxing Choices for Managing Natural Resources, the Environment, and Global Climate Change. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-22606-9_4.
Rico, M., Benito, G., Salgueiro, A.R., Díez-Herrero, A., Pereira, H.G., 2008. Reported tailings dam failures: a review of the European incidents in the worldwide context. J. Hazard. Mater. 152 (2), 846–852. https://doi.org/10.1016/j.jhazmat.2007.07.050.
Ross, M.L., 2012. The Oil Curse: How petroleum Wealth Shapes the Development of Nations. Princeton University Press.
Ross, M.L., 2015. What have we learned about the resource curse? Annu. Rev. Polit. Sci. 18, 239–259. https://doi.org/10.1146/annurev-polisci-052213-040359.
Sefa-Nyarko, C., 2026. Beyond geopolitics: social license and supply chain risks of critical minerals. Energy Res. Soc. Sci. 131, 104490. https://doi.org/10.1016/j.erss.2025.104490.
Sefa-Nyarko, C., Sinclair, D., Matanzima, J., Alver, J., Hamman, E., Bartos, S., Burke, R., 2025. Relative trust in critical minerals governance for just transitions in Ghana and Australia. Resour. Policy 103, 105568. https://doi.org/10.1016/j.resourpol.2025.105568.
Sinclair, L., Coe, N.M., 2024. Critical mineral strategies in Australia: industrial upgrading without environmental or social upgrading. Resour. Policy 91, 104860. https://doi.org/10.1016/j.resourpol.2024.104860.
Smith, S.A., Duncan, A.A., 2022. Systematic and scoping reviews: a comparison and overview. Semin. Vasc. Surg. 35 (3), 464–469. https://doi.org/10.1053/j.semvascsurg.2022.09.001.
Sovacool, B.K., 2019. The precarious political economy of cobalt. Extr. Ind. Soc. 6, 915–939. https://doi.org/10.1016/j.exis.2019.05.018.
Söderholm, P., Svahn, N., 2015. Mining, regional development and benefit sharing in developed countries. Resour. Policy 45, 78–91. https://doi.org/10.1016/j.resourpol.2015.03.003.
Suchman, M.C., 1995. Managing legitimacy: strategic and institutional approaches. Acad. Manag. Rev. 20 (3), 571–610. https://doi.org/10.5465/amr.1995.9508080331.
Surma, K., 2023. Corruption and rights abuses are flourishing in lithium mining across Africa, a new report finds. In: inside Climate News. https://insideclimatenews.org/news/15112023/lithium-mining-africa-human-rights-violations-corruption/. Accessed 4 Jan 2024.
Tienhaara, K.S., 2009. The Expropriation of Environmental governance: Protecting Foreign Investors At the Expense of Public Policy. Cambridge University.
Thurber, M.C., Hults, D.R., Heller, P.R., 2011. Exporting the "Norwegian model": the effect of administrative design on oil sector performance. Energy Policy 39 (9), 5366–5378. https://doi.org/10.1016/j.enpol.2011.05.027.
Thomson, I., Boutilier, R.G., 2011. Social license to operate. In: Darling, P. (Ed.), SME Mining Engineering Handbook. Society for Mining, Metallurgy and Exploration, Littleton, CO, pp. 1779–1796.
Tyukavina, A., Hansen, M.C., Potapov, P., Parker, D., Okpa, C., Stehman, S.V., Kommareddy, I., Turubanova, S., 2018. Congo Basin Forest loss dominated by increasing smallholder clearing. ScienceAdvances 4 (11). https://doi.org/10.1126/sciadv.aat2993.
United Nations Environment Programme, 2019. Global mercury assessment 2018 (United Nations). https://wedocs.unep.org/20.500.11822/27579.
U.S. Department of State, 2026. Critical Minerals Ministerial. *U.S. Department of State Office of the Spokesperson*. Published 4 Feb 2026. https://www.state.gov/releases/office-of-the-spokesperson/2026/02/2026-critical-minerals-ministerial. Accessed 5 Feb 2026.
US Geological Survey, 2022. Mineral Commodity Summaries. US Geological Survey. https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-lithium.pdf.
Vanclay, F., Hanna, P., 2019. Conceptualizing company response to community protest: principles to achieve a social license to operate. Land 8 (6), 101. https://doi.org/10.3390/land8060101.
Verweijen, J., Schouten, P., O'Leary Simpson, F., Zirimwabagabo Pascal, C., 2022. Conservation, Conflict and Semi-Industrial Mining: The Case of Eastern DRC. (Analysis and Policy Briefs; No. 49). University of Antwerp, Institute of Development Policy. https://research.rug.nl/en/publications/conservation-conflict-and-semi-industrial-mining-the-case-of-east-2/.
Verweijen, J., Wakenge, C.I., 2015. Understanding Armed Group Proliferation in the Eastern Congo. Political Settlements Research Programmes Briefing Papers, no, 7. Rift Valley Institute, London.
Wakenge, C.I., Bashwira, M.R., Bergh, S., Cuvelier, J., 2021. From 'conflict minerals' to peace? Reviewing mining reforms, gender, and state performance in Eastern Democratic Republic of Congo. Extr. Ind. Soc. 8, 100894. https://doi.org/10.1016/j.exis.2021.100894.
Weng, L., 2025. Unlocking the potential of critical minerals extraction for Africa's structural transformation. SOAS Centre for Sustainable Structural Transformation (CSST), Working paper, Number | 005. https://www.soas.ac.uk/sites/default/files/2025-02/Unlocking%20the%20Potential%20of%20Critical%20Minerals_WP5.pdf.
Wang, K., Ke, W., 2024. Social sustainability of communities: a systematic literature review. Sustain. Prod. Consum. 47 (2024), 585–597. https://doi.org/10.1016/j.spc.2024.04.031.
World Bank, 2022. Mine Closure: A Toolbox For Governments. World Bank, Washington DC. https://documents1.worldbank.org/curated/en/278831617774355047/pdf/Mine-Closure-A-Toolbox-for-Governments.pdf.
Yao, K.A.F., Atto, Y.D.S., Chiayé, L.K., Salze, D., Koffi, Y.B., Lopez-Ferber, M., 2025. Environmental evaluation of the mining industry, proposal of a new method: mining environmental impact assessment methodology (MEIAM). Appl. Ecol. Environ. Sci. 13 (3), 64–82. https://imt-mines-ales.hal.science/hal-05324445/.