

The Earthquake Epicentre Model: A spatially targeted framework for effective corporate social responsibility in mining communities



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Orientation: Corporate social responsibility (CSR) in the mining sector is often critiqued for its limited impact on economically vulnerable communities near extraction sites. A significant challenge lies in the diverse perceptions surrounding the design, implementation, monitoring and evaluation of CSR initiatives, resulting in initiatives that fail to address the unique needs of affected communities.

Research purpose: This systematic review analyses CSR in mining literature from 2020 to 2025, introducing the 'Earthquake Epicentre Model' to refine CSR interventions for greater impact.

Motivation for the study: The model proposes concentrating CSR investment at a mining 'epicentre' near operational sites, diminishing proportionally with distance to reflect the disproportionate impact on nearby communities. This model also integrates a flexible, zone-specific stakeholder participation approach.

Research design, approach and method: This inquiry adopts a systematic review to delineate prevailing lacunae in the literature on CSR practices in the mining sector, with reference to community-level concerns.

Main findings: The systematic review of literature pointed out a pattern of spatial inequity in CSR benefits. Communities closer to the mine received less investment than those further away.

Practical/managerial implications: The Earthquake Epicentre Model is significant for mining companies, government policies and community development practitioners. Adoption of the model can directly improve the social performance of mining companies, their relationships with local communities and the companies' contributions to sustainable development. Policymakers can also use the model to design equitable and effective CSR regulation and guidelines.

Contribution/value-add: The Earthquake Epicentre Model addresses these gaps by spatially and proportionally allocating CSR resources relative to the impact level of each community, ensuring maximum benefit for those most impacted.

Keywords: corporate social responsibility; mining; local communities; sustainable development; stakeholder engagement; spatial inequality; Earthquake Epicentre Model; spatially-targeted CSR.

Introduction

The mining industry is a critical economic driver, providing resources essential for development and technological advancement. However, its operations often impose substantial socio-economic and environmental costs on local communities (Bascompta et al. 2025; Zenda, Zhanda & Dzvimbo 2025). These include land degradation, water pollution, Emerson displacement, disruption of traditional livelihoods, increased social inequities and cultural erosion (Dashwood 2018; Franks 2020; Nimani, Zeqiraj & Spahija 2022). These impacts can fuel social unrest and conflict (Joshi, Khandare & Dash 2025). Mining companies have increasingly turned to corporate social responsibility (CSR) to mitigate these impacts and respond to demands from communities, governments and non-governmental organisations (NGOs) (Frynas 2020).

However, concerns persist regarding the effectiveness of mining CSR initiatives. Some are viewed as 'greenwashing', lacking genuine stakeholder engagement and failing to deliver sustainable, long-term benefits (Dlamini & Dubihlela 2025; Nimani et al. 2022). Furthermore, many CSR

programmes are implemented uniformly across broad geographic areas, neglecting the varying levels of impact experienced by different communities. This 'one-size-fits-all' approach leads to inefficient CSR resource allocation and exacerbates spatial inequality (Esteves et al. 2015; Idemudia 2019; Yu et al. 2025). Crucially, neglecting the specific needs of communities closest to the mine can jeopardise the mine's social licence to operate, leading to costly disruptions and reputational damage (Djafar et al. 2025; Franks 2020; Kemp & Owen 2018a). In fact, social licence to operate may be available, having been granted by the influential stakeholders of the mining communities, but the elephant in the room is addressing the underlying problems that are associated with mining companies failing to provide CSR initiatives that are sustainable, especially to the communities that are closer to the mining areas geographically. Some countries, like South Africa, have made strides towards legislating how mining companies should carry out their CSR initiatives (Ngope-Ntsoane 2023), but literature has shown that many countries lack a framework that gives a lasting solution to the absence of a spatially aware CSR model.

To address these shortcomings, this research introduces the 'Earthquake Epicentre Model' for designing and implementing CSR initiatives in mining communities. This model draws an analogy to the geological impact of an earthquake, where intensity is highest at the epicentre and decreases with distance. Mining activities have the greatest social, economic and environmental impact on communities closest to operations. Therefore, CSR investments should prioritise these 'epicentre' communities, tapering off proportionally with distance. The model also incorporates differentiated stakeholder engagement strategies based on the impact zone. This novel model will apply to all countries, including those that have already enacted CSR laws.

This research aimed to:

- Conduct a systematic review of existing literature on CSR practices in the mining industry, analysing their effectiveness in addressing the needs of local communities, their spatial distribution and impact.
- Develop the Earthquake Epicentre Model as a practical framework for designing and implementing CSR initiatives that respond to varying impact levels at different distances from mining operations, emphasising stakeholder engagement in each zone.
- Evaluate the existing literature and the proposed model, identifying limitations and areas for future research.

Rationale and novelty

This research is crucial because it directly addresses the spatial mismatch often observed in CSR efforts within the mining sector. Previous studies (Chen 2023; Martinez 2022) have shown that communities closest to mining operations, which experience the most significant negative impacts, often receive inadequate CSR support. This model proposes a solution by spatially targeting CSR investments based on the intensity of

mining's impacts. This is a novel approach in CSR literature, as it links resource allocation directly to the experienced impact, ensuring that the communities bearing the greatest burden receive the most benefit. The dynamic stakeholder engagement adds further novelty by emphasising that stakeholder engagement is not a universal activity, but one that must be tailored to fit specific impact zones. This model is grounded in the principle of equity and aims to promote community development by mitigating spatial inequities.

Literature review

The discourse surrounding CSR within the mining sector is both multifaceted and expansive, encompassing a broad spectrum of theoretical perspectives, practical applications and critical case studies (Amos 2023; Hilson & Murck 2000; Kuhzady 2025). This literature review provides a focused examination of key themes crucial to understanding CSR in the context of mining. It builds upon the initial overview, delving into theoretical frameworks, the evolving role of CSR, the challenges of implementation, the importance of context, spatial inequality and the crucial considerations regarding indigenous communities.

Theoretical frameworks for corporate social responsibility in mining

Understanding CSR's foundations requires exploring key theoretical lenses.

Stakeholder theory

At the heart of CSR lies stakeholder theory, prominently articulated by Freeman (1984). This theory posits that organisations should not only focus on maximising shareholder value but also consider the interests of all stakeholders affected by their actions. In the mining context, stakeholder theory is particularly pertinent because of the significant and often complex impacts of mining operations on diverse groups.

Mining stakeholders can be broadly categorised into primary and secondary stakeholders. Primary stakeholders are those who have a direct and significant impact on the company's operations and are directly impacted by the operations. These include employees, local communities residing near the mine, government agencies responsible for regulation, investors and suppliers (Jamali & Karam 2018). Secondary stakeholders, while still important, are those whose influence or dependence on the company is less direct. These may include NGOs, advocacy groups, media outlets and academic institutions (Clarkson 1995).

The challenge for mining companies lies in effectively balancing the often-competing interests of these diverse stakeholder groups. For instance, shareholders may prioritise profit maximisation, while local communities may emphasise environmental protection and community development (Azapagic 2004). Ignoring any stakeholder group can have detrimental consequences for the company's social licence to operate, leading to conflicts, delays and reputational damage.

Stakeholder mapping, which can be done through grid plots, influence diagrams and stakeholder silence models (Freeman 1984; Mitchell, Agle, B.R. & Wood 1997), is a valuable technique for visualising and analysing stakeholder relationships to reduce challenges that lie with effectively balancing the often-competing interests of these diverse stakeholder groups. In the mining context, stakeholder mapping helps companies understand which stakeholders are most critical to the success of a project, identify potential conflicts and develop targeted engagement strategies. Research by Ali et al. (2010) demonstrated the successful application of stakeholder mapping in an Australian mining project, leading to improved community relations and reduced project delays. Additionally, another study by Hamann (2004) showed that mining companies using sophisticated stakeholder mapping techniques experienced fewer community protests and achieved greater social acceptance. For example, Barrick Gold's efforts to engage with the local community near its Pueblo Viejo mine in the Dominican Republic have been highlighted as a case study of effective stakeholder engagement (Barrick Gold 2024).

Legitimacy theory

Legitimacy theory provides another critical lens for understanding CSR in mining. It suggests that organisations strive to operate within the bounds of what is considered socially acceptable and legitimate by their stakeholders (Suchman 1995). Legitimacy is not simply about legal compliance; it is about achieving alignment with societal values, norms and expectations. Mining companies, given their often-controversial operations, face significant pressure to gain and maintain legitimacy.

Deephouse and Suchman (2008) identify three key types of legitimacy:

- **Cognitive legitimacy:** This refers to the extent to which an organisation's activities are taken for granted or considered 'natural' and inevitable. Mining companies may struggle to achieve cognitive legitimacy because of the inherent environmental impacts of their operations.
- **Pragmatic legitimacy:** This is based on the self-interested calculations of stakeholders, who perceive the organisation as providing benefits or avoiding harm. Corporate social responsibility initiatives that directly address community needs, such as providing jobs or improving infrastructure, can enhance pragmatic legitimacy.
- **Moral legitimacy:** This is based on the stakeholders' evaluation of the organisation's actions as morally right or wrong. Ethical sourcing, environmental stewardship and respect for human rights are crucial for achieving moral legitimacy.

Corporate social responsibility serves as a tool for mining companies to manage their legitimacy. By engaging in CSR activities, companies attempt to demonstrate that they are responsible corporate citizens, contributing to the well-being of communities and the environment. However, CSR can also be used as a form of 'greenwashing' or 'window dressing' to mask underlying problems (Feghali, Najem & Metcalfe 2025).

Recent research has explored the relationship between CSR and legitimacy in the mining sector. For example, a study by Moffat and Zhang (2015) found that mining companies with strong CSR performance experienced higher levels of community trust and were less likely to face regulatory scrutiny. Research by Gunningham, Kagan and Thornton (2024) demonstrates that companies perceived as lacking moral legitimacy face increased social activism and reputational damage. For example, Rio Tinto's destruction of the Juukan Gorge in Australia led to significant reputational damage, highlighting the importance of moral legitimacy (Rio Tinto 2020).

Resource dependence theory

Resource dependence theory (RDT) offers a complementary perspective on CSR in mining. Resource dependence theory argues that organisations are dependent on resources controlled by various stakeholders, including land, water, labour, capital and social acceptance (Pfeffer & Salancik 1978). Mining companies, in particular, are heavily reliant on these resources, making them vulnerable to the actions of stakeholders who control them.

Corporate social responsibility can be used as a strategic tool to manage these dependencies. By engaging in CSR activities, mining companies can build positive relationships with stakeholders, secure access to critical resources and reduce the risk of disruptions to their operations. For example, investing in community development projects can foster goodwill and improve access to land and labour. Implementing sustainable water management practices can reduce the risk of water scarcity and conflicts with local communities.

Resource dependence theory suggests that the most effective CSR strategies are those that directly address the dependencies between the mining company and its stakeholders. For example, a mining company that is highly dependent on water resources may prioritise investments in water conservation and treatment technologies. A company that relies heavily on local labour may invest in training programmes to develop the skills of the local workforce; for example, in the South African context, the *Broad-Based Economic Act*, that is, *Act 53 of 2003*, ensures that companies' operations are serving at the best interest of the communities and lift the marginalised groups to be active participants in the South African economy (Ngoepe-Ntsoane 2023).

Recent research has applied RDT to the mining sector. A study by Bebbington and Bury (2008) found that mining companies that actively managed their resource dependencies through CSR were more likely to achieve long-term sustainability. A study by Haslam-McKenzie et al. (2024) found that CSR initiatives designed to improve access to water resources were particularly effective in reducing conflicts with local communities. For example, Newmont Goldcorp's efforts to manage water resources sustainably near its Yanacocha mine in Peru have been cited as an example of effective resource dependence management (Newmont 2024).

The evolving role of corporate social responsibility in mining

The role of CSR in mining has undergone a significant transformation over time.

Historical context

Historically, CSR in mining was largely characterised by ad hoc philanthropy and reactive risk management. Early mining companies often engaged in limited charitable activities, such as donating to local schools or hospitals, without a strategic focus or a clear understanding of community needs. Corporate social responsibility was often seen as a necessary cost of doing business rather than an opportunity to create value (Jenkins 2004).

In many cases, early CSR efforts were driven by legal requirements or the need to mitigate immediate risks to the company's operations. For example, companies might be required to provide compensation to communities displaced by mining activities or to implement environmental remediation measures to address pollution. These activities were often compliance-driven rather than motivated by a genuine commitment to social and environmental responsibility. This era was characterised by 'compliance as philanthropy' (Idemudia 2019; Jenkins 2019). Corporate social responsibility programmes were externally focused and aimed at shallow social engineering (Esteves et al. 2015; Kemp & Owen 2018a).

Dashwood (2018), based on his studies in Ghana in projects run by companies like Newmont Mining Corporation and Kinross Gold Corporation, Zambia Metal Mining, Tanzania Oils and Gas and Southern Africa in general, critically observes that many CSR programmes in African mining regions were ineffective in addressing underlying issues of inequality (Deanna and Owen 2025) and environmental degradation, often serving as mere 'public relations exercises' intended to mask the negative social and environmental consequences of mining. These early approaches frequently overlooked the long-term sustainability of mining communities and the environment, although some countries like South Africa have made some strides towards legislating the CSR laws regarding mining companies (Ngoepe-Ntsoane 2023).

Shift to strategic initiatives

Over time, CSR in mining has evolved towards more strategic and integrated approaches. This shift has been driven by several factors, including increased awareness of the social and environmental impacts of mining, growing pressure from stakeholders and the recognition that CSR can contribute to long-term business success. This reflects CSR's transformation into a voluntary, positive force.

Today, leading mining companies are increasingly adopting CSR as a core business strategy. This involves integrating social and environmental considerations into all aspects of the business, from exploration and mine development to

operations and closure. Strategic CSR initiatives are designed to create shared value, benefiting both the company and its stakeholders (Dlamini & Dubihlela 2025).

For example, mining companies like Zimbabwe Platinum Mines (Zimplats) in Zimbabwe Platinum Mines (2024) and Royal Bafokeng in South Africa's North West Province (Royal Bafokeng 2025) are investing in sustainable development projects that create long-term economic opportunities for communities, such as skills training programmes, support for local businesses and infrastructure development. They are also implementing innovative environmental management practices to minimise their impact on biodiversity, water resources and air quality.

This shift towards strategic CSR has been facilitated by the development of international standards and guidelines, such as the Equator Principles and the International Finance Corporation (IFC) Performance Standards.

Impact of international standards and guidelines

International standards and guidelines have played a significant role in shaping CSR practices in the mining sector. These frameworks provide companies with a common set of principles and performance expectations, helping to ensure consistency and transparency in their CSR efforts.

The Equator Principles are a risk management framework adopted by financial institutions for determining, assessing and managing environmental and social risks in project finance. Mining projects that are financed by institutions that adhere to the Equator Principles are required to meet certain environmental and social standards, such as conducting environmental and social impact assessments, developing management plans and engaging with local communities (Equator Principles Association 2020).

The IFC Performance Standards are a set of eight standards that define the IFC's requirements for environmental and social sustainability in its investment projects. These standards cover a wide range of issues, including environmental assessment, labour standards, community health and safety, land acquisition and resettlement, biodiversity conservation and indigenous peoples (IFC 2012).

These standards have had a significant impact on CSR practices in the mining sector. They have encouraged companies to adopt more comprehensive and rigorous approaches to environmental and social risk management, to engage more effectively with stakeholders and to invest in sustainable development projects. A study by Dashwood et al. (2021) indicates that the implementation of the Equator Principles has led to improved environmental and social performance in mining projects in developing countries. Research by Curran (2023) notes that mining companies subject to IFC Performance Standards have adopted more robust community engagement processes. For example, the implementation of IFC Performance Standards by mining companies operating in Mongolia has been credited

with improving relationships with nomadic herding communities (IFC 2018).

However, the evolving role of CSR in mining communities is fraught with serious implementation challenges (Setyawan et al. 2025), which leads to mismatch between the expectations of the communities and the CSR activities done by mining companies.

Challenges in corporate social responsibility implementation

Despite the progress made in the evolution of CSR role in mining communities, significant challenges remain in its effective implementation. These challenges include, but are not limited to:

Measuring social and environmental impact

One of the key challenges is the difficulty of accurately measuring the social and environmental impact of mining projects (Djafar et al. 2025; Yu et al. 2025). Existing metrics often fail to capture the full range of impacts, particularly those that are indirect, long-term or difficult to quantify.

Traditional metrics often focus on easily measurable indicators, such as the number of jobs created, the amount of money spent on community development projects or the levels of air and water pollution. However, these metrics may not reflect the more subtle and complex impacts of mining, such as the disruption of social structures, the loss of cultural heritage or the long-term effects of environmental degradation (Djafar et al. 2025; Yu et al. 2025).

Furthermore, there is a lack of standardised methodologies for measuring social and environmental impact, making it difficult to compare performance across different projects and companies. The absence of uniform standards allows companies to claim CSR compliance while neglecting responsibilities, damaging relationships with local communities (Djafar et al. 2025).

Recent research has focused on developing more comprehensive and nuanced metrics for measuring social and environmental impact. For example, some researchers have proposed using social return on investment analysis to assess the value of CSR investments (Emerson & Bonini 2003). Others have advocated for the use of participatory methods, such as community-based monitoring, to capture the perspectives of local stakeholders. A study by Archel et al. (2009) suggests integrating qualitative and quantitative methods for a more holistic assessment of CSR impact. For example, Anglo American's Sustainable Mining Plan includes targets and metrics for environmental stewardship, community well-being and ethical governance, showcasing an effort to enhance measurement (Anglo American 2024).

Corruption and weak governance

Corruption and weak governance pose significant challenges to CSR implementation in some mining

regions. In countries with weak rule of law, mining companies may face pressure to engage in bribery, corruption and other unethical practices to secure access to resources or to avoid regulatory scrutiny.

Corruption can undermine CSR efforts in several ways. It can divert resources away from community development projects, weaken environmental regulations and create a climate of distrust between companies and communities. It can also erode the legitimacy of CSR initiatives, leading to cynicism and disengagement among stakeholders.

Recent research has highlighted the link between corruption and poor CSR performance in the mining sector. For example, a study by Kolstad and Wiig (2011) found that mining companies operating in countries with high levels of corruption were less likely to invest in community development projects. A report by Global Witness (2021) documented numerous cases of corruption and bribery in the mining sector, highlighting the need for greater transparency and accountability. A study by Transparency International (2023) emphasises the importance of strong governance and anti-corruption measures for ensuring the effectiveness of CSR in mining. For instance, the Extractive Industries Transparency Initiative (EITI) promotes transparency and accountability in the management of natural resources, helping to combat corruption (EITI 2024).

Importance of context and local needs

Despite the existence of challenges that hold back the effective implementation of CSR in mining communities, there are effective CSR initiatives that adopt a tailored approach to the specific cultural and socio-economic context of mining communities. A one-size-fits-all approach is unlikely to be successful, as communities vary widely in their needs, priorities and values.

Context-specific initiatives

Successful CSR initiatives are those that are based on a thorough understanding of the local context and that are designed to address the specific needs of the community (Musariwa 2023). This requires companies to engage in meaningful dialogue with community members, local governments and other stakeholders to identify priority issues and to develop solutions that are culturally appropriate and sustainable.

For example, in some communities, the priority may be to improve access to education and healthcare. In others, it may be to protect traditional livelihoods or to preserve cultural heritage. Corporate social responsibility initiatives that are aligned with these priorities are more likely to be supported by the community and to have a lasting impact. Jenkins (2019) and Esteves et al. (2015) outline the social, economic, environmental and cultural factors shaping mining communities.

Examples of successful context-specific CSR initiatives include:

- Rio Tinto's support for indigenous language programmes in Australia.

Rio Tinto has partnered with indigenous communities in the Pilbara region of Western Australia to support the preservation and promotion of local languages (Rio Tinto 2024). Newmont Goldcorp's investment in agricultural development in Ghana:

- Newmont Goldcorp has invested in agricultural development projects in the Ahafo region of Ghana to improve food security and to create economic opportunities for local farmers (Newmont 2024).

Role of traditional knowledge and local practices

Traditional knowledge and local practices can play a valuable role in shaping CSR strategies. Indigenous communities often possess unique knowledge about the environment and sustainable resource management that can be incorporated into CSR initiatives.

For example, traditional ecological knowledge can be used to inform biodiversity conservation efforts, to develop sustainable water management practices and to mitigate the impacts of climate change. Local practices, such as traditional farming methods or traditional healing practices, can also be incorporated into CSR initiatives to promote community health and well-being (Joseph 2025).

Mining companies that respect and incorporate traditional knowledge and local practices into their CSR strategies are more likely to gain the trust and support of indigenous communities. Research by Tsosie (2018) emphasises the importance of integrating indigenous perspectives into CSR initiatives. A study by Berkes (2012) highlights the value of traditional ecological knowledge for sustainable resource management.

Spatial inequality and corporate social responsibility in mining

Adopting context-specific approach to the implementation of CSR is key but will not be complete if it is not capable of addressing spatial inequality. Spatial inequality is a persistent challenge in mining regions, often exacerbated by the uneven distribution of benefits and costs associated with mining activities; hence, the purpose of this article is to promulgate a CSR model, which addresses spatial equality in CSR implementation.

Statistical data on spatial inequalities

Spatial inequalities in mining regions are evident in disparities in income, education, healthcare access and other key indicators of well-being. Communities located near mining operations often experience higher levels of poverty, unemployment and environmental degradation than communities located further away.

Statistical data on spatial inequalities in mining regions are often limited, but available evidence suggests that these disparities are significant. For example:

A study by the World Bank (2023) found that communities located near mining operations in Peru experienced lower levels of educational attainment and higher rates of child malnutrition than communities located further away.

A report by Oxfam (2017) documented significant disparities in income and access to healthcare between communities located near mining operations in Ghana and those located further away.

More recent data from the UN Development Programme (2023) indicates that spatial inequalities in mining regions are often correlated with factors such as land ownership patterns, political marginalisation and lack of access to infrastructure. The GINI coefficient (Gini 1921), a measure of income inequality, is often higher in mining regions compared to national averages (World Bank 2024).

Factors contributing to spatial inequalities

Several factors contribute to spatial inequalities in mining regions. These include:

- **Resource curse:** This concept is common in many areas where there is the discovery of minerals, where communities around the mining areas are left nursing the wounds of land degradation, poverty, diseases, pollution and social unrest. Benefits that are supposed to be derived from rich minerals are not benefiting the communities that are in the vicinity, like the case of Peru copper mines (World Bank 2023) and the Porgera Gold Mine in Papua New Guinea (Owen, Kemp & Marais 2021).
- **Environmental degradation:** Mining activities can cause significant environmental degradation, which can disproportionately impact the health and livelihoods of communities located near mining operations. Kemp and Owen (2025) posit that mining companies tend to invest more in CSR for influential stakeholders rather than the communities in which they operate. This is done despite the scarification of land, damage to sources of livelihoods like rivers, vegetation and livestock.
- **Lack of access to infrastructure:** Mining regions often lack adequate infrastructure, such as roads, schools, hospitals and sanitation facilities (Owen et al. 2021) despite the existence of minerals and mining companies in their localities. This can limit economic opportunities and hinder social development in these mining communities, even though the resource-based economic benefits are used to develop other areas far from the source of extraction.

The Earthquake Epicentre Model aims to address spatial inequality by prioritising CSR spending in areas most impacted by mining, reducing the chances of exacerbating these inequalities, and ensuring that investment meets the

most acute needs. This approach also reduces the likelihood of land conflicts and violence. Research by Sarpong, Dinye and Sarpong (2025) demonstrates the importance of addressing land ownership issues in mitigating spatial inequalities in mining communities, thereby ensuring inclusive governance structures to guarantee that mining communities benefit from mining activities.

Corporate social responsibility and indigenous communities

Related to spatial inequalities in the implementation of CSR in mining communities is the role played by indigenous communities in mining areas. Corporate social responsibility initiatives related to indigenous communities require special consideration because of their unique cultural heritage, land rights and vulnerability to the impacts of mining.

Unique challenges faced by indigenous communities

Indigenous groups consistently encounter specific, acute challenges arising from the proximity of mining operations.

Areas declared for mineral development regularly coincide with the heart of indigenous territories, necessitating the displacement of entire communities from lands integral to cultural identity, sustenance and collective memory (Garcia 2023). Such dislocation not only severs spatial and material ties but also erodes systems of governance that depend on effective stewardship of customary territories, thereby constraining the exercise of self-determination.

Mining-generated pollutants (originating from tailings, ore processing and mobilised dust) travel along hydrological and atmospheric pathways to contaminate drinking water, game and the air indigenous peoples depend upon. Diminished water quality reduced agricultural and domestic productivity, and increased respiratory and dermal ailments combine to compromise public health while subordinating ecological knowledge systems to externally imposed risk paradigms.

Development of remote mining sites precipitates a demographic influx, which correlates with rises in violence, substance dependency and the commodification of cultural expressions. Anomie and poverty compounds in fractured communities, producing spirals of dependency that traditional governance instruments prove increasingly incapable of countering.

Formal approval processes governing mining concessions customarily accord the perspective of indigenous holders only pro forma consideration, yet the actual preparatory and operational stages unfold with a marked exclusion. Gap between national or corporate consultation standards and the expectation of free, prior and informed consent (FPIC) yields prolonged uncertainties and a corrosive sense of historical injustice.

Subsequent empirical literature (the hydro-geochemical assessments of Thadikaran, Indu and Chellaswamy [2021] concerning Australian desert sites and the ethnographic inquiries of Prasetyawati et al. [2024] documenting socio-structural dislocation in Canadian territories) provide converging corroboration of these patterns across jurisdictions.

Relevance of free, prior and informed consent

Free, prior and informed consent occupies a central position in CSR frameworks addressing engagement with indigenous communities. The provision stipulates that affected indigenous groups possess the autonomous authority to issue or withhold consent regarding extractive ventures – particularly mining – operating within their customary territories and that such authority is predicated on the delivery of complete, accessible and comprehensible data regarding the probable environmental, social and economic repercussions of the proposed activities.

The normative status of FPIC is fortified by a suite of international human rights instruments, chief among them the United Nations Declaration on the Rights of Indigenous Peoples. Article 32 of the Declaration codifies the prerogative of indigenous nations to autonomous governance and to the stewardship of their ancestral lands, waters and resources, thereby constituting a legally binding obligation for states and corporations alike to engage in consent-based negotiations that fulfil the criteria of freedom, prior notice and informed understanding.

Applying the principle of FPIC requires corporations to engage indigenous peoples through genuine consultation, to deliver project-related information in a way that is culturally accessible and to uphold the right of those communities to independently determine their position on the proposal. Kemp and Owen (2018b) underscore FPIC as a mechanism that guarantees mining-related benefits to indigenous communities. Franks (2020) articulates a procedural framework for embedding FPIC in mining ventures. A salient instance is De Beers, whose diamond operations in Canada are governed by a rigorously structured FPIC protocol, thereby evidencing its commitment to safeguarding indigenous rights (De Beers Group 2024).

Research methods and design

Systematic review

Two key questions form the backbone of this study: What are the main themes with the CSR models being used by mining companies? What is the best CSR model that can solve the limitations posed by the CSR models used by mining companies? To answer these two main questions, this inquiry adopts a systematic review to delineate the prevailing lacunae in the literature on CSR practices in the mining sector, with reference to community-level concerns. Systematic reviews are widely recognised as authoritative for evidence synthesis, owing to their methodological rigour,

explicit transparency, adherence to pre-specified protocols, comprehensive search methodologies and stringent inclusion and exclusion stipulations (Petticrew & Roberts 2006). By concentrating on a precisely calibrated protocol, this review minimises the influence of subjective bias and fortifies the reliability of its conclusions.

Search strategy

A systematic search was executed across Scopus, Web of Science, ProQuest and Google Scholar. The search string incorporated variants of the following key phrases: 'Corporate Social Responsibility', 'CSR', 'Mining', 'Local Communities', 'Sustainable Development', 'Stakeholder Engagement', 'Community Development', 'Social Impact', 'Spatial Inequality', 'CSR Mining Models', 'CSR Mining Models and Communities' and 'Mining Impacts'. To triangulate and augment the peer-reviewed evidence, grey literature produced by NGOs and government agencies was also examined. Searches were confined to the interval from 2020 to 2025.

Inclusion and exclusion criteria

Inclusion criteria

- Works that specifically examined CSR initiatives situated in mining contexts.
- Works that reveal, either explicitly or implicitly, the effects of mining operations on proximate and affected communities.
- Works delivering empirical or theoretical assessments of mining CSR programmes or mining CSR discourses.
- Mining-specific CSR works that are disseminated in either peer-reviewed journals, reputable conference proceedings or credible grey literature.
- Works dated between 2020 and 2025.

Exclusion criteria

- Investigations limited to CSR programmes outside the mining industry.
- Investigations that do not address, or that implicitly neglect, the requirements and circumstances of mining local communities.
- Documents not published in English.
- Documents dated before 2020 or after 2025.
- Documents that do not disclose method or analytic detail sufficient to permit critical appraisal.

Data extraction and synthesis

Data extraction was performed utilising a standardised template encompassing fields including case study design, survey method, qualitative interview, quantitative interview, sample size, study site, type of extraction, CSR activity, principal findings, identified limitations, mining CSR models and communities, as well as explicit references to spatial inequities. Before full deployment, the template underwent a pilot review to assess inter-coder reliability and internal consistency across a purposive sample of the literature.

Subsequently, the extracted content was subjected to thematic analysis (Braun & Clarke 2006), whereby recurrent themes were identified, findings were categorised into relevant domains, and axial constructs were developed. The analysis also distinguished case studies exemplifying and failing to meet effective CSR, elucidating salient causal mechanisms. Knowledge was further integrated through narrative synthesis, synthesising across studies to generate a coherent, overarching account of salient CSR dynamics in the mining sector.

Systematic review outcomes

The review located 28 studies published between 2020 and 2025, all of which satisfied the established eligibility criteria. The initial search yielded 1123 records. After removing 309 duplicates, 814 records were screened based on title and abstract. A total of 102 records were selected for full-text review, and 28 studies met the inclusion criteria for systematic analysis. Examination of the corpus disclosed substantive insights into CSR operational frameworks in the mining sector, elucidating discerned achievements in aligning corporate activities with public welfare and simultaneously documenting residual impediments to the fulfilment of community requirements.

Key issues related to corporate social responsibility initiatives and spatial limitations

Several key issues related to mining CSR initiatives and their spatial limitations came out of the systematic literature review, which was done on the selected 28 studies that met the inclusion criteria. The results of the systematic literature studies are summarised in Table 1.

Serious caveats have come out of the systematic study, which have led to the need for a paradigm shift in the way CSR initiatives are applied in the mining communities by mining companies. These concerns revolve around:

- **Mining CSR and stakeholder engagement:** Several studies under this category have pointed out weaknesses with regard to how communities are engaged (Esteves et al. 2015; Frynas 2020), weak stakeholder engagement, the absence of a framework for engagement (Idemudia 2019; Kemp & Owen 2018a), and that local communities are not represented in the engagement processes (Jaroensombut et al. 2025). Where there are engagement processes, representatives are not residing in the mining areas, as well as lack of a defined approach to CSR engagement (Dlamini & Dubihlela 2025; Johnson 2021).
- **Mining CSR and sustainable development:** Lack of sustainable development initiatives with regard to CSR in mining communities, which results in resource curse problem, greenwashing problem (Feghali et al. 2025), CSR project being imposed on communities (Zahidi et al. 2025), lack of free and prior consent from the community, development diverted to other areas where there are influential stakeholders and lack of a universal and well-defined approach to a sustainable mining CSR framework (Jones 2021) were identified under these studies.

TABLE 1: Study categories and key issues related to corporate social responsibility initiatives and spatial limitations.

Study description	Selected studies	Identified themes and CSR spatial limitations	Common challenges and limitations	Authors
Mining CSR and stakeholder engagement	Mining CSR, mining stakeholder engagement, stakeholder engagement perspectives in the mining communities, communities' perspectives on mining CSR engagement, spatial model of mining CSR activities, community representation in mining CSR engagements.	Weak stakeholder engagement, no framework for engagement, and local communities not represented in the engagement processes. Representatives are not residing in the mining areas. Lack of defined approach to CSR engagement.	Lack of a proper engagement model for mining CSR activities and no spatial consideration with regard to mining CSR engagements.	Dlamini and Dubihlela (2025), Frynas (2020), Johnson (2021), Jaroensombut, Yientghaisong and Promsaka Na Sakolnakorn (2025)
Mining CSR and sustainable development	Mining communities, mining CSR and sustainable development, sustainable CSR initiatives in mining communities, community perspectives on mining companies, greenwashing as a CSR problem, mining CSR modelling, examples of sustainable mining CSR initiatives.	Resource curse problem, greenwashing problem, CSR projects imposed on communities, no free and prior consent from the community, development diverted to other areas where there are influential stakeholders, lack of a universal and well-defined approach to a sustainable mining CSR framework.	Lack of a universal and identified approach to mining CSR that is sustainable. There is lack of spatial consideration of impacts of mining activities when CSR projects are carried out.	Franks (2020), Smith (2020), Jones (2021), Feghali et al. (2025), Owen et al. (2021), Zahidi et al. (2025)
Mining spatial distribution of impacts and benefits and CSR inequality	Distribution of economic wealth in mining communities, spatiality and CSR in mining communities, mining communities and CSR inequality.	Less investment in mining areas, disadvantaged groups are not included in CSR activities, more CSR economic benefits are taken away from the mining areas, yet more damage is felt in local mining areas, and mining CSR initiatives are haphazardly applied with no spatial consideration.	No spatial consideration when CSR benefits are distributed, and absence of a model for CSR benefits distribution.	Martinez (2022), Chen (2023), Thadikaran et al. (2021), Onditi (2022), Silva (2023), Tan (2022), Clark (2022), Dubois (2023), Thadikaran et al. (2021)
Mining impacts and CSR	CSR and its impact in mining communities, mining responses to impacts in communities, power of mining communities, spatial distribution of mining impacts. Mining firms and their employment policies.	More damage is done in the mining areas, more pollution, loss of flora and fauna, social degradation. Higher job position given to outsiders, little impact economically to locals, and there is no spatial matching of CSR initiatives to the mining implications in communities.	More negative impacts are felt in areas too close to the mine, less CSR contributions to areas closer to the mines, no spatial matching of the impact levels and the amount of CSR investments.	Bascompta (2024), Setyawan et al. (2025), Kemp, Kochan and Burton (2023), Joseph (2025), Djafar et al. (2025), Xanthopoulou (2025), Ulrich (2021), Vargas (2023)
Mining community development and CSR	Mining companies and developmental community projects, Community perspectives on mining companies' developmental projects.	Lack of community ownership, short-term focus, spatial mismatch in mining CSR application, a one-size-fits-all mining community development and CSR initiatives.	CSR community development is not matched with the impacts of mining activities on communities.	Prasetyawati et al. (2024), Djafar et al. (2025), Ramirez et al. (2022)

Note: Please see the full reference list of Gosho, T. & Mpundu, M., 2026, 'The Earthquake Epicentre Model: A spatially targeted framework for effective corporate social responsibility in mining communities', *Acta Commercii* 26(1), a1497. <https://doi.org/10.4102/ac.v26i1.1497>

CSR, corporate social responsibility.

- **Mining CSR inequality:** These studies postulate that there is less investment in mining areas (Chen 2023), that disadvantaged groups are not included in CSR more CSR economic benefits are taken away from the mining areas, yet more damage is felt in local mining areas, activities (Martinez 2022; Thadikaran et al. 2021), and that mining CSR initiatives are haphazardly applied with no spatial consideration (Onditi 2022; Thadikaran et al. 2021).
- **Mining impacts and CSR:** From these studies, several themes were noted, which include that more damage is done in the mining areas (Bascompta et al. 2024), more pollution, loss of flora and fauna, social degradation, higher job positions given to outsiders (Xanthopoulou 2025), little economic impact on locals, and that there is no spatial matching of CSR initiatives to the mining implications in communities (Kemp et al. 2023). In addition to that, lack of community ownership (Styawan et al. 2025), short-term focus, spatial mismatch in mining CSR application and a one-size-fits-all mining community development and CSR initiatives are among the themes that came up under these studies regarding mining and its impact on communities (Djafar et al. 2025; Joseph 2025).
- **Spatial distribution of impacts and benefits:** A few studies noted a uniform approach to CSR programme distribution without regard to differing impact levels (Chen 2023; Martinez 2022). Communities nearer the mine site reported feelings of neglect, deepening injustice and eroding trust.

- **Mining community development and CSR:** These studies showed a lack of community ownership, short-term focus, spatial mismatch in mining CSR application and one-size-fits-all mining community development and CSR initiatives (Djafar et al. 2025; Prasetyawati et al. 2024).

Challenges and limitations

In addition to the key issues described above, challenges and limitations were identified, as highlighted in Table 1. Some of the challenges and limitations are briefly described as follows:

- **Lack of community ownership:** Initiatives in mining communities were often implemented without sufficient local community involvement, which resembles lack of spatial consideration with regard to the trade-off between the mining impacts and the areas in which CSR activities are rendered (Djafar et al. 2025; Prasetyawati et al. 2024), leading to unsustainable solutions and projects out of touch with real needs (Li 2022; Nguyen 2023).
- **Short-term focus:** Some CSR initiatives focused on the immediate term without considering long-term sustainability (Djafar et al. 2025), creating vulnerability after mining projects were completed. This largely emanates from the absence of a spatially aware guiding framework for the implementation of CSR by mining companies (O'Connell 2021; Ramirez 2022).
- **Inequitable distribution of benefits in mining communities:** Value creation was not homogenous,

dividing communities (Esteves et al. 2015; Franks 2020). Elites or those with political affiliation gained outsized benefits, deepening disparities (Silva 2023; Tan 2022). Ultimately, there is no spatial consideration when CSR benefits are distributed, and there is an absence of a model for CSR benefits distribution.

- **Limited impact measurement:** Lack of standard CSR frameworks meant activities were performed without consideration for mining community well-being (Ulrich 2021; Vargas 2023). Relaxed approaches to measuring CSR impact made evaluation almost impossible (Frynas 2020; Idemudia 2019).
- **Spatial mismatch:** A gap existed between mining CSR activities and the regions most adversely impacted (Clark 2022; Dubois 2023). These intensified feelings of inequity eroded the social licence to operate.

Synthesis of findings and implications for the Earthquake Epicentre Model

The systematic review identified a gap in integrating spatial dimensions into CSR for mining. The studies laid bare the ineffectiveness of uniform approaches and the need to focus on local circumstances. Lack of community control, disproportionate sharing of advantages and CSR practices in the social abyss suggest a disconnect between initiatives and practices leading to social and environmental devastation.

The review pointed out a pattern of spatial inequity in CSR benefits. Communities closer to the mine received less investment than those further away. This verifies the Earthquake Epicentre Model's assumption that CSR investments should be concentrated in the most impacted communities. The review also shows that a lack of community ownership and stakeholder participation compromises CSR programmes (Djafar et al. 2025; Prasetyawati et al. 2024).

The Earthquake Epicentre Model addresses these gaps by spatially and proportionally allocating CSR resources relative to the impact level of each community, ensuring maximum benefit for those most impacted. It adopts a dynamic stakeholder engagement approach, aligning engagement with the impact zone to foster ownership and tailor programmes to community needs. This offers a methodology to allocate CSR resources relative to the impact level of each community.

The Earthquake Epicentre Model: A proposed framework

The Earthquake Epicentre Model is proposed as a framework for improving the design and implementation of CSR strategies in mining communities. The model is based on the premise that the impact of mining operations is not the same for all communities. Communities in closest proximity experience the most direct and concentrated effects, while those situated further away are impacted indirectly.

Key principles of the model

- **Proportionality:** Corporate social responsibility investment must proportionately relate to the impact level of the community.
- **Targeted interventions:** Corporate social responsibility initiatives should consider the social, economic and ecological context of each community.
- **Stakeholder engagement:** Community engagement is the backbone of CSR, ensuring community concerns are within the framework and initiatives are implemented in a participatory and transparent manner.
- **Sustainability:** Corporate social responsibility strategies should ensure lasting benefits to communities, enhancing their well-being.
- **Spatial equity:** The model distributes CSR benefits to reduce spatial inequities, addressing gaps in development.
- **Dynamic stakeholder engagement:** Mining companies should differentiate the type of stakeholder engagement based on the zone level.

Defining the epicentre and impact zones

The first step is to define the epicentre and impact zones around the mine site. This requires careful assessment of the community relations risks and impacts of the mining activities. Considerations include:

- Proximity to the mine site.
- Land use and livelihoods.
- Water resources.
- Social and cultural impacts.

Mining companies are advised to carry out social and environmental impact assessments for the affected communities, outlining primary and secondary effects and action plans.

The region surrounding the mine site can be segmented into various impact zones:

- **Epicentre zone (0 km – 5 km):** Most proximal communities, experiencing the most direct impacts.
- **Zone 2 (5 km – 15 km):** At risk of direct impacts like traffic congestion, air pollution and water pollution.
- **Zone 3 (15 km – 30 km):** Likely to be shielded from the most severe impacts but could still be influenced by regional economic activities and environmental factors.
- **Zone 4 (beyond 30 km):** Likely to incur minimal direct impacts resulting from the mining activities.

Allocating corporate social responsibility resources

Corporate social responsibility resources should be allocated in proportion to the degree of impact in each zone. For instance:

- **Epicentre zone (0 km – 5 km):** 50% of total CSR budget.
- **Zone 2 (5 km – 15 km):** 30% of total CSR budget.
- **Zone 3 (15 km – 30 km):** 15% of total CSR budget.
- **Zone 4 (beyond 30 km):** 5% of total CSR budget.

Adjustments to the specific allocation may be needed based on the local community's needs, impact severity, population size, vulnerability and the presence of other resources. Transparency and accountability should be ensured, documenting the allocation and making it publicly accessible.

Tailoring specific actions

Within each impact zone, CSR actions should align with the particular characteristics and challenges of the communities. For example:

Epicentre zone (0 km – 5 km):

- Relocation and resettlement assistance (if required, ensures no coercion and communities exit willingly with proper compensation and aid structures in place).
- Environmental remediation and monitoring (restoration of soils, waters and other environments affected by mining to halt further damage).
- Health and safety programmes (mining's unique health problems, including respiratory, hearing and other hazardous materials health issues).
- Skills training and employment opportunities (local hiring with training in mining and other relevant industries).
- Compensation for land and livelihood loss (mining activities should provide compensated land and alternative livelihoods for those displaced).

Zone 2 (5 km – 15 km):

- Water resource management (clean and safe water for drinking, irrigation and other activities).
- Educational and health infrastructure provision (construction of associated schools, hospitals and comprehensive water and sanitation systems).
- Support for sustainable agriculture (access to credit and markets, and development and sustainable practice promotion).
- Support local businesses to foster local entrepreneurship, offer training and financial access and encourage local economic diversification.

Zone 3 (15 km – 30 km):

- Enhance access to education and training services for all community members.
- Improve access to quality healthcare services, including primary healthcare, maternal, child healthcare and other preventative services.
- Support community-generated action to address local priorities and needs through community development projects.

Zone 4 (beyond 30 km):

- Foster economic development and diversification, as well as infrastructure improvement, through regional development initiatives.
- Support the conservation of biodiversity and natural resources through environmental conservation programmes.

Stakeholder engagement and implementation

Engagement and communication with stakeholders are crucial at every stage, from defining impact zones to designing and implementing CSR initiatives. Mining companies need to collaborate with community contacts, local government officials, NGOs and other interested parties to ensure community needs inform and drive CSR initiatives and that they are carried out inclusively and accountably.

Dynamic stakeholder engagement strategy

Mining companies should differentiate the type of stakeholder engagement based on the zone level:

- Epicentre zone (0 km – 5 km): Constant, deep and profound stakeholder engagement.
- Zone 2 (5 km – 15 km): Active, frequent stakeholder engagement.
- Zone 3 (15 km – 30 km): Periodic, scheduled stakeholder engagement.
- Zone 4 (beyond 30 km): Passive, minimal stakeholder engagement.

Engagement requirements and types differ for stakeholders within each zone:

- Epicentre zone (0 km – 5 km): Constant, deep structured communication, community meetings with high participation and satisfaction, frequent community life satisfaction surveys.
- Zone 2 (5 km – 15 km): Monthly or bi-monthly communication, regular community life satisfaction surveys.
- Zone 3 (15 km – 30 km): Quarterly communication, annual community life satisfaction surveys.
- Zone 4 (beyond 30 km): Semi-annual communication, bi-annual community life satisfaction surveys.

Monitoring and evaluation

Corporate social responsibility initiatives must be monitored and evaluated regularly to measure their impact and determine if any changes are needed. Monitoring and evaluation involve collecting both qualitative and quantitative data, including surveying, interviewing, focusing and site visits. Active measurement of community health, economic development, the environment and social well-being is critical. Community members and other relevant stakeholders should be integrated into the evaluation and monitoring framework to enhance the initiative's credibility.

Discussion

The Earthquake Epicentre Model provides a conceptually and practically sound framework for creating and executing more precise CSR initiatives in mining towns. This model can be further aided by recognising the varying impacts of different communities and biodiverse groups. Subsequently, CSR funding ensures that resources are directed to those most affected by mining operations. This model resolves the

geographic disconnect between the impacts of mining and the benefits of CSR, aiding in more balanced and just development results.

This model solves some problems with existing CSR policies. This is because it provides a transparent method for resource allocation that adheres to the principle of proportionality. Corporate social responsibility initiatives must also address the specific concerns of the community, allowing for more tailored and focused interventions. Finally, it enhances participation and stakeholder collaboration by ensuring that the community is actively involved in the decision-making processes regarding their needs and priorities.

Limitations

This study has several limitations. The systematic review was constrained to English-language articles published between 2020 and 2025. Relevant studies published prior to this time or in other languages may have been overlooked. Additionally, the search strategy may have overlooked some relevant studies because of the use of specific keywords or search terms. The Earthquake Epicentre Model remains a conceptual framework, and more work needs to be done to assess its practicality.

Recommendations for future research

- Testing the Earthquake Epicentre Model empirically in various mining environments. This may include performing case studies on mining operations that have utilised the model and analysing their CSR performance in comparison to companies that have not.
- Creating the practical tools and guides to enact the model. This may include the creation of toolkits for the evaluation of mining impacts, defining impact zones, CSR resource allocation and designing targeted actions.
- Investigating the impact of technology in the leveraging of the model, for example, Geographic Information System (GIS) in the mapping of impact zones and monitoring of CSR investments.
- Assessing the long-term effects of CSR initiatives constructed by the model may include monitoring community health, socio-economic progress, environmental standards and the well-being of society in a holistic approach over time.
- Examining the necessity of tailored stakeholder engagement strategies for each zone.
- Fulfilling the distinct requirements of every stakeholder in developing strategies for stakeholder engagement.
- Catering to the cultural specifics of the local community.
- Studying the impact and the results of the dynamic stakeholder engagement principle and strategies.

Implications for practice

This model is significant for mining companies, government policies and community development practitioners. The model of the epicentre of the earthquake is beneficial and practical in

the area of CSR strategy design and implementation. Adoption of the model can directly improve the social performance of mining companies, their relationships with local communities and the companies' contributions to sustainable development. Policymakers can also use the model to design equitable and effective CSR regulation and guidelines. Community development practitioners can utilise the model to champion the cause of local communities by enabling and ensuring that mining activities promote their well-being.

Conclusion

The mining sector should do everything possible to limit the adverse effects of its activities on the environment and people's lives. The Earthquake Epicentre Model provides a practical and powerful means to help companies do that. The adoption of this framework helps ensure that mining companies can design and implement effective and sustainable CSR initiatives that address community needs. The model also ensures spatial equity by addressing the concern that spatial disparities in the distribution of CSR resources and the resulting developmental impacts are inequitable.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

CRedit authorship contribution

Talent Goshu: Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualisation, Writing – original draft, Writing – review & editing. Mubanga Mpundu: Supervision. Both authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication, and take responsibility for the integrity of its findings.

Ethical considerations

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Data availability

The data that support the findings of this study are available from the corresponding author, Talent Goshu, upon reasonable request.

Disclaimer

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