



Working with the community for the rehabilitation of legacy mines: Approaches and lessons learned from the literature

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1. Background and rationale

The extraction of natural resources is inevitable in a globalised and modern society. The mining sector has significantly contributed to the advancement of people's lives and boosted the economies of many countries. The life cycle of a mine starts with exploration and prospecting, followed by the approval process, mine development and production, and eventually, mine closure and rehabilitation. However, with improper enactment of policies and guidelines, especially in low-income and developing countries, improper reclamation programs, or a lack thereof, mining companies may leave their sites without rehabilitation, creating legacy mines. "Thousands of mines sit in an idle state of 'care and maintenance' partly because of the difficulties involved in closing a mine and concerns about transfer of residual liability for sites" (Measham et al., 2024, p.1). Legacy mines are also known as derelict or abandoned mines whose rehabilitation strategies or management are typically implemented by the government (Tabelin et al., 2021).

The abandonment of mines exacerbates people's negative views and perceptions about mining (Alonzo et al., 2023; Promentilla et al., 2021). Even if they have ceased operations, some legacy mine sites continue to cause environmental and human health hazards (Coelho et al., 2011). Aside from environmental and social risks (Bank of Ghana, 2003; Boon et al., 2013), health and safety issues (Brenner and Pruent, 2006), the closure of mines may significantly impact local and national economies, especially if workers lose their jobs, creating immense psychological effects on individuals and entire communities (Pini et al., 2010). In other

words, legacy mines come with many issues that, when not resolved, may continue to pose risks. Also, given that the demand for ores will continue to increase in the next decades to achieve a clean energy transition (WBC, 2021), issues on mine closure rehabilitation are critical.

With these issues related to legacy mines, government agencies around the world are pushing for their rehabilitation to return them to safe and stable conditions. Rehabilitation initiatives aim to sustainably make the mined-out land productive to support the economic activity of the host community and their future generations. In the context of this paper, we used the word sustainability to mean minimising the negative environmental and social impacts while increasing the economic and natural capital of the site (Adam et al., 2021; Deveci et al., 2022). One of the key approaches to legacy mine rehabilitation, particularly in economic and environmental development, is working with the host community, the local community made up of people living in the mining area. There are competing conceptualisations on how to work with them. For example, community engagement is an attempt to develop good relations through genuine conversations, developing mutual respect and trust by including all those who are key players of a broad section of the community in the discussion (Australian Government, 2016). Meanwhile, community participation occurs when the community mobilises its resources, takes responsibility for its own development activities, and shares in decision-making for and implementation of all other developmental programs for the overall improvement of the community's status (Boon et al., 2013; Hasan, 2022). Finally,

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community involvement happens when community members actively participate in the planning, implementation, management, monitoring, and evaluation (Palanisami et al., 2007; Hasan, 2022).

These different ways of working with host communities are all encompassed by the term community development. Community development promotes self-reliance, critical awareness, and problem-solving skills among community members. The community, likewise, becomes empowered to begin recommended programs or programs they have conceptualised as they see them as essential for their development. Community development, which should be the goal of mining companies, scientists, and engineers, is about contributing to the host community by building their capacity and agency to meet their needs and aspirations themselves, both now and into the future, and not do the development for them (Isacowitz et al., 2022).

Although the concepts of community engagement, participation, involvement, and empowerment have been widely used, there are multiple knowledge bases regarding their conceptualisation, implementation, and evaluation of impacts within mine closure and rehabilitation. There are also diverse approaches used with conflicting evidence for their effectiveness. This paper investigates how community engagement, participation, involvement, and empowerment are studied, viewed, and reported in the literature. We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to explore the literature to answer our research questions below.

1.1. Research questions

1. How are the mining companies engaging the community in the rehabilitation of legacy mines investigated and reported in the literature?
2. What are the major approaches used?
3. What are the challenges in engaging the community in the rehabilitation of legacy mines?

Our paper aims to contribute to the conceptualisation of community engagement, participation, and community involvement, including how they are studied, defined, and implemented. From the synthesis of the relevant literature, we developed a theoretically driven continuum of practice that can be used to better engage the community in the rehabilitation of legacy mines.

2. Literature review

This section provides an overview of what has been done in this area of research, including reported outcomes of community engagement, issues regarding approaches to legacy mine rehabilitation, and understanding of working with the community and the rationale for implementing it.

Community engagement meaningfully include people in the host community to develop solutions to various issues affecting them, ensuring effective implementation and sustainable outcomes. The aspiration is to involve the local people, who are directly impacted by programs at various levels of the process, to ensure that the decisions made are not from regulatory bodies and local government units only (Walker, 2020). Although there are positive outcomes of community engagement in the rehabilitation of legacy mines, there is also evidence that this process does not always bring significant improvement to the lives of the host community members, the physical environment or the economic aspect of the community. These varied outcomes may be caused by issues related to the conceptualisation, design, and implementation of community engagement and the intent of mining companies to ensure compliance only and not to have a positive legacy after operation. These issues are discussed in the succeeding sections.

Bassler et al. (2018) argued that there are five fundamental principles of a successful or effective community engagement. Specifically, community engagement must (1) increase citizens' knowledge about a

community and/or the issue being addressed, (2) encourage citizens to co-create additional knowledge and understand and apply that knowledge, (3) use that knowledge to improve the community's condition or to address any identified problem, (4) create future opportunities for citizens to engage each other, and lastly, (5) ensure that these opportunities and effective communications become a regular and on-going component of the process.

The varying definitions of community empowerment from professionals and experts, including institutions and organisations, converge on the following concepts: collaboration, communication and continuity, and empowerment. In defining community engagement, proponents emphasise partnering with affected members of the community in the design, implementation, and interpretation of the engagement process. This definition is not only exclusive to the rehabilitation stage but broadly applies across the life stages of the mine. It can be observed from the posited definitions that collaboration through various forms, such as dialogues, partnerships, and working together, among others, is presented as the guiding principle and core of community engagement. Approaches in community engagement range from consultation, where citizens have limited power to influence decision-making, to partnership and (shared) leadership, where citizens are delegated decision-making control. The five approaches in the spectrum of community engagement differ based on the level of decision-making the community is delegated with (Barnes and Schmitz, 2016). Informing is where the community is merely provided with balanced and objective information about projects and services, including the rationale behind choosing them. Meanwhile, consulting invites feedback from the community on alternatives and analyses of the existing programs for the conceptualisation of newer services whilst also letting them know how their feedback and suggestions have influenced engagement decisions.

3. Methods

We used the PRISMA guidelines to answer our research questions. PRISMA is a widely used framework for reporting and synthesising literature reviews due to its rigour in searching databases, reporting guidance, and process transparency (Moher et al., 2009). The combination of keywords, use of inclusion and exclusion criteria, and use of manual search apart from databases enhance the rigour of the process. We followed the four steps to review the relevant studies: (a) identifying research literature from database searches, (b) screening articles using inclusion and exclusion criteria, (c) assessing full-text articles for eligibility, and (d) coding and reporting the final articles included in the review as shown in Fig. 1.

3.1. Step 1: data sources and literature search

We explored three electronic databases: Scopus, Web of Science, and ProQuest to search for articles related to the rehabilitation of legacy mines. These databases were considered to comprehensively cover the literature in mining, environmental, social, and a wide range of other disciplines. There were no restrictions on the articles' subject, discipline, and date searched. A consistent search string query was utilised with Boolean operators in all databases. However, it is important to note that while this study utilised a stringent search strategy, several iterations were made to understand the research area beyond the research questions identified. As familiarity with the literature grew, there were subtle revisions to the search terms initially selected until the team finally decided to formalise the search string. Table 1 presents the search string query used in this study, and a total of 142 articles were found from all the three databases considered.

3.2. Step 2: study selection

Fig. 1 illustrates the multi-stage screening process to evaluate and select relevant studies identified in the search. The initial result

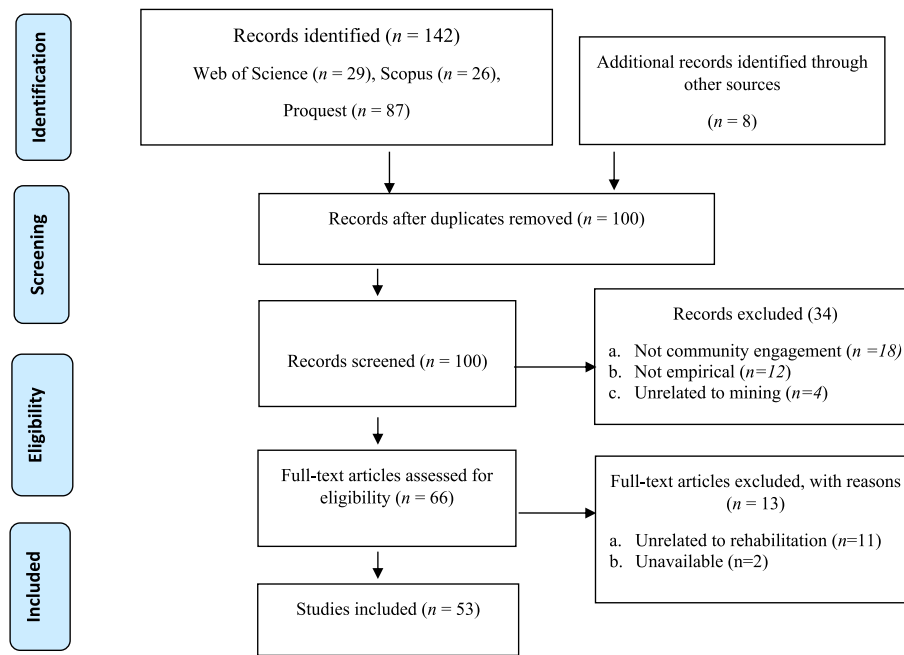


Fig. 1. The study selection process based on the PRISMA guidelines.

Table 1
Keywords used for literature search.

Database	Keywords	Number of Articles
Web of Science	TS = ((community) AND (engagement OR partnership OR empowerment) AND (rehabilitation OR reconstruction OR reclamation OR remediation) AND (mine OR mining))	29
Scopus	TITLE-ABS-KEY ((community) AND (engagement OR partnership OR empowerment) AND (rehabilitation OR reconstruction OR reclamation OR remediation) AND (mine OR mining))	26
ProQuest	noft (community) AND noft (participation OR engagement OR empowerment OR partnership) AND noft (rehabilitation OR reconstruction OR reclamation OR remediation) AND noft (mine OR mining)	87
TOTAL		142

indicated that the search strategy used in Stage 2 picked up many irrelevant articles. The search string query provided structure and conditional filtering studies from the selected databases. Also, a database-specific filtering mechanism using document type (scholarly journal articles and conference proceedings) was employed to refine the results further. The search filtered only scholarly journals and conference proceedings to be included in the search. Due to resource limitations, only those articles published in English were included. All articles were imported to Microsoft Excel, which was used to remove duplicates.

A total of 142 articles were extracted from the three databases. Furthermore, a ‘snowball’ technique was applied in which citations within articles were searched if they were relevant (Hepplestone et al., 2011), and as a result, eight additional articles were extracted from this process. Forty-two articles were duplicates and, therefore, removed. Two authors independently read the abstracts of the 100 articles to assess their relevance. Any paper that the two authors disagreed with was moderated by a third author who read the entire paper. After the iterative process, 47 papers were considered irrelevant (not related to the community role in rehabilitation, not empirical, and not related to mining), with only 53 articles ultimately included in the study (Fig. 1).

3.3. Step 3: accessing full-text articles

After the initial screening, the 53 relevant articles were downloaded for subsequent full-text article review. We used the following exclusion criteria to assess the final inclusion of the papers. The paper must.

1. Report about participation, engagement or involvement of the host or local community for rehabilitation of legacy mine;
2. be a peer-reviewed journal; not a review article, not a conference proceeding, not a report, not a book publication nor a book chapter, not a theoretical paper;
3. be written in English; and
4. be accessible and the full text is available.

3.4. Step 4: coding and reporting the results

The coding criteria were initially guided by the research questions, focusing on community participation, engagement or involvement in the rehabilitation of legacy mines. The initial code includes location, research design, conceptualisation, approach, reported outcomes, challenges, factors influencing, and recommendations. Moreover, open coding was done to capture themes not covered by the initial codes.

File classification was employed using Microsoft Excel to provide article categorisation based on bibliographic attributes, including publication year, publication type, author, and database provider. Similarly, case classification was used to categorise according to certain attributes such as research type, methodology, use of theory or published framework, study sector, sampling protocol and contexts. These categorisations were reviewed and pre-tested before implementation.

This stage included collating, summarising, and reporting the review results. This study presents a narrative account of the existing literature through thematic analysis with minimal regard to the weight of evidence to the extent of data use or specific interventions toward data use. The coded information allowed us to develop relevant themes and descriptive analyses of the selected studies’ extent, nature, and distribution.

4. Results and discussion

We present the findings of our literature review following our research questions.

4.1. Summary of reported studies

This section answers the research question: *how is engaging the community in the rehabilitation of legacy mines investigated and reported in the literature?* The summary of studies can be found in [Appendix A](#).

Country. Most of the studies were conducted in Canada and the USA (16%), followed by Australia and the United Kingdom (10%), Brazil, Ghana, Indonesia, and Peru (6%), Colombia (4%) and Chile, Finland, Georgia, Guatemala, Myanmar, Namibia, Nigeria, South Africa, and Papua (2%). One study did not indicate a country.

Types of Resources. The most common resources extracted were gold (27%), coal (16%), copper (11%), bauxite (6%), silver (6%), uranium (6%), iron (5%), oil (5%), zinc (3%), lead (2%), gas (2%), molybdenum (2%), oil sands, hydro, and other radioactive materials (3%), and not specified (8%).

Research Design. Several research designs were used, including qualitative (56%), mixed methods (33%), and quantitative (11%).

Methods. Data were generated using interviews (24%), surveys (13%), observation (11%), participatory approach (10%), semi-structured interviews (10%), document analysis (8%), literature review (7%), cost-benefit analysis/impact analysis/plasma (5%), geographic information system (GIS) mapping (5%), focus group (2%), decision analysis (2%), citizen science approach (2%), and others such as experiment and indigenous research methodologies (1%).

Positionality of Authors. Of the 53 studies, 50 studies were in the context of researchers reviewing community engagement undertaken by mining companies; one study in the context of researchers undertaking the community engagement on behalf of the mining, and two studies have the same positionalities.

Definition of Community. No single definition of community was used in the articles reviewed. One paper ([Keenan et al., 2016](#)) used Australia's Department of Resources, Energy and Tourism definition of community as 'a group of people living in a particular area or region' (2006). Some papers defined community according to the context in which it is used, i.e., community-based on occupation, industry, or ecology. For example, community refers to the inhabitants of immediate and surrounding areas affected by a company's activities (RET, 2006; Ministerial Council on Mineral and Petroleum Resources, 2005). In this sense, the community is identified in terms of people and post-mining environments, including mapping their values, knowledge, and perspectives ([Kivinen et al., 2018](#)). In terms of community within specific ecologies, the definition is tied to the interests of people affected by issues related to 'water rights' where water is linked with specific place-based ecologies involving community, culture, and identity ([Fraser and Kunz, 2018](#); [Sosa et al., 2017](#); [Stough-Hunter et al., 2014](#); [Torso et al., 2020](#)), and traditional occupations affected by mining such as coffee industry ([O'Brien et al., 2021](#); [Schwartz et al., 2021](#)) or agriculture ([Chukwuma, 2011](#); [Withanachchi et al., 2018](#)). Finally, some papers defined community in terms of upholding the rights and identity of 'indigenous', 'aboriginal', and 'First Nations' ([Annandale et al., 2021](#); [Babidge, 2013](#); [Blesia et al., 2021](#); [Meadows et al., 2019](#); [Menton et al., 2021](#); [Monosky and Keeling, 2021](#)).

4.2. Major approaches used

This section answers the research question: *what are the major approaches used and the outcomes reported?*

Six major approaches are used: consultation and dialogues, research, corporate-community partnership, community activism and resistance, gender lens approaches, and social justice.

Consultation and Dialogues. Consultation with the host community

provides insights to mining companies on how to develop rehabilitation strategies. Consultation explores the host community's concern about mining's impact on their natural environment, economic, social, and cultural resources and needs. Stakeholder consultation takes the form of enquiries ([Annandale et al., 2021](#)), navigating through trade-offs among diverse and often conflicting perspectives during decision-making, trust building efforts through collaborative partnerships ([Cooper and Wardropper, 2021](#); [Ramirez-Andreotta et al., 2016](#)), and engagement in risk-informed decision making ([Fraser and Kunz, 2018](#); [Branko et al., 2022](#)), and public dialogues to acquire host community approval (e.g., social license and CSR; [Holley and Mitcham, 2016](#)).

Through consultation and dialogues, relevant community inputs are used to inform mine closure plans ([Annandale et al., 2021](#)), competing perspectives of stakeholders are accounted ([Cooper and Wardropper, 2021](#); [Ramirez-Andreotta et al., 2016](#)), best options are identified and selected ([Fraser and Kunz, 2018](#)), social license and corporate social responsibility are addressed ([Branko et al., 2022](#); [Holley and Mitcham, 2016](#)), as well as socio-political struggles and risks are dealt via negotiation ([Hirons et al., 2014](#)).

Co-design approach is another important approach for a mining company to engage communities. This approach involves the mining companies co-designing strategies for post-mining interventions. Below are several examples of community engagement via research activities. Four research activities integrate community involvement.

First is assessment planning. This is the identification of the needs, wants and priorities of stakeholders through the design and creation of frameworks at various stages of mining (e.g., environmental assessment phase, post-closure mine planning, mine remediation, final land use in reclamation; environmental remediation; social and economic impact mitigation) using methods such as community-informed conceptual site model framework ([O'Brien et al., 2021](#); [Prno et al., 2021](#)), various risk perception assessments ([Withanachchi et al., 2018](#); [Stough-Hunter et al., 2014](#)); engagement of communities in planning for final land use ([Setiawan et al., 2021](#)); and decision-making regarding resource and land use, environmental conservation, and policymaking/regulatory framework ([Monosky and Keeling, 2021](#); [Chukwuma, 2011](#)); and development of a dual-mode model of trust and confidence as a framework for understanding the pivotal role of trust in the development of the mine remediation plan ([Jardine et al., 2013](#); [Ramirez-Andreotta et al., 2016](#)).

Engaging the local community in assessment planning has led to the following outcomes: inclusion of local knowledge and perspectives, creation of a context-specific approach ([O'Brien et al., 2021](#); [Prno et al., 2021](#)), detection of people's risk perceptions and concerns on multiple risk factors and desire for action ([Withanachchi et al., 2018](#); [Stough-Hunter et al., 2014](#)). The voices of the people are heard, making social aspects of mine closure prominent ([Monosky and Keeling, 2021](#); [Chukwuma, 2011](#)), and it builds trust and confidence between mining operators and the local community ([Jardine et al., 2013](#); [Ramirez-Andreotta et al., 2016](#)).

Second, mapping exercises or GIS mapping. Through participatory GIS and thematic mapping exercises, knowledge of local communities is integrated into the history and treatment of post-mining sites to their current ecological status ([Rich et al., 2015](#); [De Lemos et al., 2009](#); [Phenrat, 2020](#); [Ramirez-Andreotta et al., 2016](#); [Kivinen et al., 2018](#)). This novel approach enables mapping risks, decision-making, and disseminating knowledge ([De Lemos et al., 2009](#); [Rich et al., 2015](#)). The GIS also enables tracking behavioural change and addressing risk communication ([Kivinen et al., 2018](#); [Phenrat, 2020](#)).

Third, designing, monitoring and evaluation framework. Involvement of the community in the development and design of monitoring and evaluation, program evaluation, and outcomes-based evaluation in the different stages of mining activities (e.g., post-mining/mine closure land rehabilitation; mine closure planning). These are practical approaches linking ecological and social outcomes of mining restoration. Program evaluation has various examples, such as evaluation of the

effectiveness of environmental governance (Darimani et al., 2013), the effectiveness of rehabilitation framework/strategy (Deveci et al., 2022; Rosa et al., 2020), and delivery of ecological and social benefits (Esteves and Barclay, 2011; Rosa et al., 2020; Nagisetty et al., 2020; Prno et al., 2021; Rosa et al., 2020, 2020).

Implementing a monitoring and evaluation framework determines effective environmental governance (Darimani et al., 2013; Prno et al., 2021), monitors community perceptions and reported outcomes (Nagisetty et al., 2020; Esteves and Barclay, 2011), delivers social benefits via rehabilitation practices, restoration efforts, and social transition subsidy (Rosa et al., 2020; Collins and Kumral, 2020) and informs decisions related to sustainability (Deveci et al., 2022).

Last is community-based participatory research (CBPR) partnership. The community plays an active role in knowledge co-creation, knowledge sharing, and research-product ownership within the context of ethical, equitable, and inclusive research agenda. The research methodology includes participatory action research (PAR) and indigenous research methodology (IRM; Saxinger & First Nations of Nacho Nyak, 2018; Torso et al., 2020; deLemos et al., 2007). The activities include (1) developing protocols and designing research; (2) identifying resources and expertise needed to complete studies that build community capacity; (3) conducting research via community meetings, acquiring language skills, and integrating local knowledge into sampling approaches.

Corporate-community partnership. This approach involves the actual implementation of activities that support mine area rehabilitation. There are three major strategies used in this specific approach. First, service delivery via corporate social responsibility (CSR), community relations and development (CSD), and engagement relationship between mining companies and host communities. The partnership covers the delivery of a range of community development programs funded from 'business' profits. These include delivering ecological benefits such as recovery and improving environmental conditions for post-mining sites (Ackermann et al., 2018; Babidge, 2013; Claassen and Roloff, 2012; Mukarrom et al., 2022; Rosa et al., 2020). In addition, the delivery of social benefits or investments like human development, human rights, health, education, welfare, cultural preservation, and physical development of infrastructure (Blesia et al., 2021; Du Preez et al., 2000) as well as participation in sustainability standards certification using best-practice design (Meadows et al., 2019).

Second, partnership agreements, including cooperative agreements and brokering agreements, aim to address community needs for vocational education and training, pre-apprenticeship training, employment, and business opportunities (Missens et al., 2007; Hodgkins, 2016; Sosa et al., 2017). These partnerships aimed to increase employment and assist work transitions from construction to post-mining operations.

Third, education and training. Community participation in education and training considers training communities for employment pre-, during, and potential livelihood post-mining; educating children about local history about environmental protection (Grimshaw and Mates, 2022); and expanding women's participation in vocational education and training, apprenticeship (Simon and Clarke, 2016), and science and technology (Torso et al., 2020).

Community activism and social justice. Stakeholders form groups within and among themselves to challenge 'business as usual', 'power status quo' and 'neo-liberal corporatism'. These are in the form of community-based groups or transnational networks. For example, some community activists seek to use cultural and traditional heritage as 'emotional regeneration' (Stephenson and Wray, 2005), while others participate in decision-making processes at local levels through complaints about environment impact assessment (EIA) and resort to transnational networks to challenge national and institutional limitations (Aguilar-Stone and Hirsch, 2017). Similarly, the social justice approach explores themes such as questioning hierarchy, decolonisation of the research process, and sustainability challenges (Torso et al., 2020). This involves making indigenous communities as junior partners in rehabilitation efforts (Hodgkins, 2016; Torso et al., 2020). This

approach has raised an equity issue due to selective decentralisation, improving only a few local actors but threatening the majority with dispossession (Adam et al., 2021). Social justice gives greater visibility for the host community to assert their rights to implement the agreed rehabilitation plan (Torso et al., 2020). Through this approach, the mining companies ensure fairness and equality in delivering rehabilitation activities, making sure that everyone in the community accrue same benefits.

Gender lens approaches. Inclusion of women in agreement processes, gendered distribution of agreement benefits, the extent to which impacts and benefits influence women's development and economic inclusion. Studies address the low participation of women in agreement processes (Keenan et al., 2016) and navigate through issues about the limited participation of women in vocational education and training and their careers related to mining (Simon and Clarke, 2016).

5. Challenges in engaging the host community

This section answers the research question: *what are the challenges in engaging the community in the rehabilitation of legacy mines?*

There are several challenges identified in the literature. The expectations, perspectives, wishes and knowledge of the community are rarely considered or even adequately addressed during decision-making processes on choosing the best options in mining operations. Plans and decisions are often made exclusively by the mining company. The host community are also excluded in planning the processes of corporate social responsibility. Exclusion or neglect of stakeholder perspectives makes it difficult for companies to gain a social license to operate (SLO) (Meadows et al., 2019). Additionally, stakeholders' expectations and perspectives are often competing. There are several ways that this issue can be addressed. The ecosystem services approach (ESAR) is used where a biophysical baseline is established and will become the basis for returning post-mining land to pre-mining conditions (Rosa et al., 2018). Another one is the adoption of a monitoring, evaluation, reporting and improvement (MERI) framework to assess mining company performance against community expectations for multiple-use mine rehabilitation (Meadows et al., 2019). Also, participatory research approaches are adopted for capacity building, data accessibility, and exploration of community goals (Torso et al., 2020). Furthermore, mixed-use, for example, post-mining forested landscapes, are implemented to support local livelihoods (Annandale et al., 2021).

Also, the exclusion of local voices and participation in assessments (health, hazard, risks), including perceptions of quality in research and their interaction with efforts to increase environmental concern, particularly in areas in need of remediation. The community's perceptions of how the local environment interacts with efforts to increase environmental concern (Stough-Hunter et al., 2014). In addition, partnerships based on community-based participatory research (CBPR) foster trust in research and impact efforts on health (Saxinger and First Nation of Na-cho Nyak Dun, 2018; Torso et al., 2020). The community voices in closure planning and goal setting mitigate the negative socio-economic impacts of mine closure (Owen and Kemp, 2018; Monosky and Keeling, 2021).

In addition, indigenous knowledge is rarely considered in planning, monitoring, research, and decision-making processes in mine operation and rehabilitation. It has been found that a community-informed conceptual site model framework is the best approach to incorporate local knowledge into contamination and remediation (Aguilar-Stoen and Hirsch, 2017). In addition, context-specific free, prior and informed consent (FPIC) implementation highlights locally adapted verification criteria and increases transparency of outcomes (DeLemos et al., 2007, 2009). Also, participatory citizen science may provide access to informal local knowledge necessary to develop an understanding of the ecology and management of urban ecosystems in a post-mining site (Kivinen et al., 2018), and citizen science approach leads to transparency, elevated democratic capacity, and public trust (Hitch et al., 2020).

Moreover, there can be misalignment between local knowledge and scientific and technical data knowledge. This is apparent in the misalignment between expectations and outcomes perceived by the community and the expected outcomes aimed by the mining companies. Top-down models for CSR and scientific data do not align with community perception and practices (Saxinger and First Nation of Na-cho Nyak Dun, 2018; Holley and Mitcham, 2016; O'Brien et al., 2021). Research studies reported that environmental health perception is used in monitoring and addressing disconnect in perceptions and messages (Nagisetty et al., 2020). This disconnect can be addressed by expanding the scope of the principles and determinants of effective environmental governance (Darimani et al., 2013), focusing on open and honest dialogue and building a mutual understanding (Blesia et al., 2021), and linking outcomes to community resources (Palmer et al., 2010).

Them, state-enacted formalisation and decentralisation are not aligned with community tenurial practices and instruments. For instance, the selective implementation of decentralisation or decentralising formalisation of rights in mining communities leads to paradoxical outcomes, often negatively impacting social, economic, and environmental sustainability (Adam et al., 2021). Decentralisation has given different actors control over mineral resource wealth to the local population, leading to institutional ambiguities wherein different actors are now claiming mineral resource wealth, leading to conflicts (Adam et al., 2021).

Furthermore, trust and mistrust exist between mining companies and local communities, as well as between researchers and communities (historical mistrust of non-native researchers). For one, there is a lack of public trust in the rehabilitation program, usually due to previous failures on the part of mining companies to contribute to the greater good. Collaborative partnerships create an opportunity to build trust and reputation capital for all parties (Fraser and Kunz, 2018). Thus, clear regulation is needed as to how a company involves the community in mine closure planning (Monosky and Keeling, 2021). There is also a challenge in terms of risk communication precipitated by a language barrier. Risk communication is complicated by language barriers (DeLemos et al., 2009), lack of infrastructure (Jardine et al., 2013), and policy framework, which limits participation.

Finally, there are sustainability issues, such as the transition of mines from construction to post-mining. Mine closure regulations remain vague when describing how companies should involve impacted communities in mine closure planning, and governments largely neglect to regulate the social aspects of mine closure. The integration of traditional owner expectations cultural- and family-based practices into the whole-of-life mine planning increases the success of the program (Annandale et al., 2021). Also, a contingency plan, including mine closure can give insurance to mitigate the potential socio-economic consequences of an unexpected mine closure (Ackerman et al., 2018).

Many studies identified factors influencing community participation. Amongst these, the policy frameworks and partnership agreements led by state and mining companies, including the inclusion of indigenous peoples in sustainability standards (Meadows et al., 2019), support the involvement of community across the life stages of the mine. However, state endorsed legal instruments like formalisation and decentralisation can be beneficial to a few and disenfranchising for many (Adam et al., 2021; Sosa et al., 2017). The prescriptive, rather than participatory, nature of the legal documents disengages the community in the process. An open and honest dialogue with the affected communities and building a mutual understanding with companies through participative and deliberative approaches enable a more effective and sustained community involvement (Blesia et al., 2021; Monosky and Keeling, 2021; Prno et al., 2021). This process of engagement, transparency, and building trust among stakeholders enhances the motivation and action of the community.

Another factor includes the mobilisation and organisation led by non-state actors such as civil society, non-government organisations (NGOs), and activist networks. An example is resistance engagements in

transnational networks. Strategic alliances between national and international experts, facilitated by national NGOs and activists acting as gatekeepers (Aguilar-Støen and Hirsch, 2017). Also, IPs and peasant groups resort to protest due to little recourse to national laws, which privilege resource exploitation over their rights (Babidge, 2013).

Also, partnership agreement, involvement in the advisory board, community fund, education and training, and employment influence community participation. Local arrangements lead to more respectful policies towards rural communities and help reduce tensions (Claassen and Roloff, 2012). Community funds address the social, environmental, and economic needs of the local communities (Missens et al., 2007). Recruitment and hiring of local people during the construction and operations phases of the mines establish a good partnership between mining companies and the community (Missens et al., 2007).

Moreover, there is an emerging theme that goes beyond mine rehabilitation. These are activities that focus on future economic services and investment to improve the ecological, economic, social, and cultural capacity. Build business capacity and maximise business opportunities within sound procurement management (Himley, 2010). Agritourism – integrating forage crops and developing cattle farms in reclaimed land for environmental recovery (Missens et al., 2007). Benefits for IPs such as the provision of traditional foods, permitting spousal visits, cultural leave, and IP language use policy (Missens et al., 2007). Cooperatives and corporate-led social investment include housing improvement, educational scholarship, breeding centres, garment manufacturing, irrigation, and other infrastructure (Mukarrom et al., 2022). Employee and family assistance programs provide rehabilitation programs and support counselling, with services provided primarily by local people.

6. Discussion and implications

This paper explored how the host community is studied, defined, and implemented in the literature. In the absence of a coherent knowledge base, our paper has contributed to understanding this construct. We showed in our literature review that positioning the host community as an integral component of mining operations is a continuum of practice. The emerging themes range from merely informing the community to transferring the leadership to the community. *Community information* involves making the community aware of the aims and goals of the project (Grimshaw and Mates, 2022). The host community receives information and does not take an active role in the program implementation and decision-making. Rosa et al. (2018) noted that despite clear legal expectations articulated in early stages of the process, and although the rehabilitation goals mention stakeholder engagement and the rehabilitated areas will be returned to the local communities, they were not directly involved in deciding post-mining land use. There is no explicit engagement of the community in various rehabilitation activities and decision-making.

Community consultation explores their views, beliefs, perceptions, aspirations, knowledge, and skills about rehabilitation (Adam et al., 2021; Aguilar-Støen and Hirsch, 2017; Annandale et al., 2021). This interaction can involve public meetings, discussion groups, polls, surveys and focus groups. For example, Holley and Mitcham (2016) reported that local people provided critical inputs for the development of the program, but they are still passive participants in the actual program implementation. The major aim of community consultations is to acquire community approval. Consultation can be a one-way communication model that aims to inform, change behaviour, and assure populations that the determined risk is acceptable (Chess and Purchell, 1999; Cox, 2013).

Community engagement builds stronger relationships between program implementers and the community (O'Brien et al., 2021; Prno et al., 2021). The host community develops psychological identification with the project. One example is company-community engagement where the company negotiated the risks and benefits of rehabilitation with the community to gain their approval (Holley and Mitcham, 2016). While

this process is promising, it was reported that engagement exercise might have been more fruitful for both parties if the negotiation of risks and benefits occurred from the beginning of the process.

Community partnership establishes collaborative work to address the shared goals and objectives of the project (Blesia et al., 2021; Monosky and Keeling, 2021; Chukwuma, 2011). In this process, the local community assumes equal responsibility and accountability for the project (Hodgkins, 2016 & Torso et al., 2020). They have equal voice and power in terms of decision-making. For example, Torso et al. (2020) documented that participatory action research and indigenous methodologies frameworks are effective in conducting more inclusive research that values partnership with the local community.

Community empowerment builds the people's strong sense of project ownership (Adam et al., 2021; Blesia et al., 2021; Jardine et al., 2013; Ramirez-Andreotta et al., 2016). The capacity of the local community for planning and decision-making are enhanced, and they assume greater role in many activities. A participatory approach was adopted by Meadows et al. (2019) established skilled citizen scientists among impacted Indigenous communities. They built their capacity in the use of innovative technological applications for assurance-related data collection and reporting, such as via mobile phones, handheld GPS/GIS devices and drones.

Leadership transfer builds the community's leadership skills to lead the implementation of the program (Caine et al., 2007; Cooper & Wardropper; Phenrat, 2020; De Lemos et al., 2009). An example of this was reported by Adam et al. (2021) where in Ghana the rehabilitation efforts were decentralised, shifting the control to local actors, increasing the local control over activities and resources whether in the hands of user groups or Indigenous communities. Another example was reported by Fraser and Kunz (2018) where all key actors were given leadership responsibility to act accordingly. While the government leads the overall initiatives, the non-government organisations, including the environmental protection groups, development agencies, and faith-based organisations work with the community to develop their leadership skills, and eventually lead the rehabilitation efforts.

While the practices within the continuum are widely used and their success is widely documented, disadvantages are also identified. *Community information* involves passive participation of the local people, and hence the acceptability of the rehabilitation activities cannot be guaranteed (Grimshaw and Mates, 2022). More often than not, people receive the services and activities but filter only those that benefit them. *Community consultation* can fall short of its intended purpose as it is typically top-down focused, and for legal compliance, prioritising technical considerations and interests of primary stakeholders such as government agencies or mining companies over local needs creates power imbalances (Aguilar-Støen and Hirsch, 2017; Himley, 2010), and fails to deliver on promises of genuine involvement (Rosa et al., 2018; Sosa et al., 2017). As a tokenistic engagement approach, consultation can further undermine trust and lead to communication breakdowns (Ramirez-Andreotta et al., 2016), ultimately hindering successful post-mine rehabilitation. In terms of *community engagement*, there are challenges in involving community stakeholders in terms of the complexity of integrating and negotiating various voices (Holley and Mitcham, 2016). For example, meaningful consideration of traditional or indigenous knowledge with scientific knowledge can require a clear investment of time, resources, and management of expectations (Amires-Andreotta et al., 2016; Prno et al., 2021). Further, the process of engagement can marginalise the local community in favour of stakeholders with greater economic or political power, which could disproportionately influence the negotiation process (Withanachchi et al., 2018). Such imbalance in power dynamics and challenges with trust and transparency can further exacerbate conflicts.

It was also reported that the success of *community partnership* could be hindered by factors such as limited communication in relation to program design and management (Esteves & Barclay), too much focus on research objectives and data can marginalise local communities,

making them data sources rather than knowledge holders (Saxinger and First Nation of Na-cho Nyak Dun, 2018), and balancing unrealistic goals, expectation and timelines (Cooper & Wardropper; Torso et al., 2020). In addition, *community empowerment* is always challenged with ensuring inclusive participation as it is difficult to guarantee effective participation for everyone, especially for Indigenous communities where capacity building may be required for them to fully contribute (Meadows et al., 2019; Wilk and Jonsson, 2013). For instance, one mechanism to empower communities is the formalisation of water rights. However, as observed by Sosa et al. (2017), communities aligning with mining companies have gained an advantage at the expense of traditional structures and sharing arrangements. Failure to distribute power fairly or equitably can lead to marginalisation of certain groups within the community. Finally, when it comes to *leadership transfer*, which can be transformational for post-mining communities, the disadvantages include: (1) decentralising/transferring power to local actors can be problematic, especially powerful elites can take advantage of the power vacuum for their personal gains over the community needs and sustainability (Adam et al., 2021); (2) ambiguous roles and overlapping claims can cause conflicts as well as loss of trust among actors such as government, NGOs, academia (Fraser and Kunz, 2018); and (3) the lack of resources and expertise can also lead to actors abdicating leadership (Fraser and Kunz, 2018).

Another notable contribution of our paper are the factors influencing rehabilitation programs of legacy mines. These factors include policy (Adam et al., 2021; Missens et al., 2007) that either support or compromise the rehabilitation effort. Also, there are factors related to people, including policymakers and regulatory officers (Babidge, 2013) and the local community (Chukwuma, 2011; Torso et al., 2020). These actors lay critical roles in the rehabilitation process, and their active involvement ensures the success of the program. In addition, there are factors associated with the process of rehabilitation. The neglect of stakeholder perspectives makes it difficult for the program to gain significant traction (Meadows et al., 2019). The failure to account for people's views and perceptions about rehabilitation builds a strong resistance of any rehabilitation activities (Owen and Kemp, 2018; Monosky and Keeling, 2021). Implementing a rehabilitation program should build people's trust in the project's aims and with external people involved in the program (Saxinger and First Nation of Na-cho Nyak Dun, 2018; Torso et al., 2020). The intersections of people's beliefs, perceptions, and knowledge and the scientific and technical data and knowledge are critical for the rehabilitation efforts' success (Nagisetty et al., 2020). People feel valued and respected when they are a central part of the rehabilitation process. There are also cultural factors, including language barriers (DeLemos et al., 2009). It is important that the local community understand program implementers to enhance the dialogic process of communication. Moreover, there are also factors associated with the mining operation's life cycle. If the local community are only involved in the rehabilitation process, but not in the early operations of the mining company, there is a high tendency that people will not participate (Annandale et al., 2021). It is vital that the local community are integrated into the whole life cycle of the mine (Ackerman et al., 2018).

Taking the findings as a body of knowledge, there are apparent gaps in the literature that warrant further investigations. First, there is no empirically tested holistic framework of effective community engagement in rehabilitation of legacy mines. Although the 54 studies reviewed highlight the critical need for engaging the community in the rehabilitation program, more studies that establish the intersections of the community and technical and scientific knowledge, including geological, economic, environmental, ecological, and hydrological characteristics of the legacy mine are needed. The intersections of these various components with the social aspect will provide a more critical evaluation of the best approach for rehabilitating legacy mines. The mining company can better create buy in and manage the host community's acceptability of the rehabilitation approach. Second, there is a need to

assess the efficacy of each approach in involving the community. The results of this assessment will provide greater clarity on the most effective approach. Third, there is also a gap in terms of understanding the role of demographics in the level of involvement of people in rehabilitation programs. We need to establish the role of gender, educational attainment, age, and socio-economic status for people's access of the program. This line of enquiry will inform our approach to working and engaging with a specific group of people. Fourth, there is little report about rehabilitation efforts' sustainability and long-term impact. Due to the nature of funding for rehabilitation. Most programs implemented are limited to only a certain number of years irrespective of the level of rehabilitation, and thus, were not sustained due to financial limitations. Finally, evaluation studies that report the long-term social impacts of rehabilitation programs are needed to broaden our understanding of the approaches being used.

Addressing these gaps also implies the need for a governance framework that makes explicit the penta-helix synergy of academia, industry, government, civil society, and the community. The community is at the centre of this partnership, as they are the ones most affected by the legacy of mining. For example, academia can provide expertise and knowledge to support rehabilitation through collaboration with government, industry, civil society and the affected community. The government has a crucial role in creating policies and regulations that promote sustainable mining practices facilitated by authentic community engagements. Governments can ensure that mining companies are held accountable for their operations' environmental and social impacts from exploration until closure and post-mine use. Mining companies must communicate and consult with the affected communities in their rehabilitation plan to repurpose the land or restore the ecosystems affected by mining activities. Likewise, civil society organisations (CSOs) play a vital role in advocating for the rights of affected communities and the environment. These organisations can raise awareness, co-monitor the impacts of mining on the environment, and support the communities. The governance framework may include measures to incentivise and support such community-centered partnerships in transitioning to sustainable landscape and mineral resource management. The protocol for a transparent community's participation and engagement is thus essential to ensure that the rehabilitation process is successful and sustainable.

7. Conclusions and limitations

This paper investigated the studies reported, the approaches used, and the challenges of engaging the host community in the rehabilitation of legacy mines.

Our findings suggest that there are many ways that the community is involved in the rehabilitation of legacy mines, ranging from community information, community consultation, community engagement, community partnership, and community empowerment to leadership transfer. Although these six categories of involving the community are commonly reported, leadership transfer is the most effective, where the local community's leadership and technical skills are enhanced to make critical decisions about and implement rehabilitation programs. Another key finding is that rehabilitation programs should consider various factors, including policy, people, process, contextual, and mining processes. The interplay of these factors either supports or hinders the local community's involvement in the legacy mine's rehabilitation.

Although our paper has followed the PRISMA to review the existing studies on community engagement in the rehabilitation of legacy mines, we only included peer-reviewed journal articles. Our exclusion criteria

may have limited our literature search. We did not review printed books and documents from the government and international agencies. Also, we did not include grey literature, including the mining companies' community engagement and consultation reports. These other publications can be considered in future systematic literature reviews. Also, our analysis of the reported literature did not account for how each related construct is evaluated to establish the relative effectiveness of each community engagement approach. Thus, a rigorous study is needed to establish empirical support for the effectiveness of each approach. Additionally, there is a need to establish the influences of policy and contextual factors in ensuring effective community engagement.

CRediT authorship contribution statement

Dennis Alonzo: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Carlito Baltazar Tabelin:** Writing – review & editing, Writing – original draft, Funding acquisition, Data curation. **Irish Mae Dalona:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Jan Michael Vincent Abril:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation. **Arnel Beltran:** Writing – review & editing, Writing – original draft, Investigation, Funding acquisition, Formal analysis, Data curation. **Aileen Orbecido:** Writing – review & editing, Writing – original draft, Investigation, Funding acquisition, Formal analysis, Data curation. **Mylah Villacorte-Tabelin:** Writing – review & editing, Writing – original draft, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Vannie Joy Resabal:** Writing – original draft, Formal analysis, Data curation. **Michael Angelo Promentilla:** Writing – original draft, Funding acquisition, Formal analysis, Data curation. **Marlon Suelto:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Pablo R. Brito-Parada:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation. **Yves Plancherel:** Writing – review & editing, Writing – original draft, Investigation, Funding acquisition, Formal analysis, Data curation. **Anne D. Jungblut:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Robin Armstrong:** Writing – original draft, Funding acquisition, Formal analysis, Data curation. **Ana Santos:** Writing – original draft, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Paul F. Schofield:** Writing – original draft, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Richard Herrington:** Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation.

Declaration of competing interest

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

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Appendix A. Studies on engaging the community in the rehabilitation of legacy mines

Study	Country	Type of resources	Research design	Methods	Types	Positionality ^a
Ackermann et al. (2018)	South Africa	Gold	Qualitative	Semi-structured interviews, focus group, observation, document analysis	Consultation, empowerment	B
Adam et al. (2021)	Ghana	Gold	Mixed methods (case study)	Semi-structured interviews, questionnaires, focus group, observation	Consultation, engagement, empowerment	B
Aguilar-Stoen and Hirsch (2017)	Guatemala	Gold, silver	Qualitative	Interviews, participant observation, review of secondary sources	Consultation, engagement	B
Annandale et al. (2021)	Australia	Bauxite	Qualitative (case study)	Observations; formal meetings, discussion, interviews	Consultation, engagement, partnership	B
Babidge (2013)	Chile	Copper	Qualitative (ethnography)	Participant observation, interviews, discussion	Engagement, partnership, leadership transfer	B
Blesia et al. (2021)	West Papua	Gold and copper	Qualitative	Interview, observation, document analysis, literature review	Consultation, engagement, partnership, empowerment, leadership transfer	B
Branko et al. (2022)	Canada, Slovenia, Belgium	Uranium, and other radioactive materials, nuclear legacy sites	Qualitative (case study)	Risk-informed decision analysis	Consultation, engagement	B
Caine et al. (2007)	Canada	Gold, uranium	Qualitative	Historical analysis, participatory research	Consultation, partnership, leadership transfer	B
Chukwuma (2011)	USA	Iron	Qualitative (case study)	Participatory research	Partnership, leadership transfer	B
Claasen and Roloff (2012)	Namibia	Gold	Quantitative	Interviews	Engagement, partnership, empowerment	B
Cooper and Wardropper (2021)	USA	Lead, silver, zinc	Quantitative	Q-sorts survey, interviews	Partnership, leadership transfer	B
Darimani et al. (2013)	Ghana	Gold	Quantitative	Survey, interviews	Partnership	B
DeLemos et al. (2007)	USA	Uranium	Mixed methods	Community meetings, integrate local knowledge into sampling approach of sediment, water, and vegetation	Engagement, partnership	B
DeLemos et al. (2009)	USA	Uranium	Mixed methods	GIS-based thematic mapping; survey: questionnaire	Partnership, empowerment	B
Deveci et al. (2022)	Not stated	Not specified	Quantitative	Survey; q-Rung Orthopair Fuzzy Sets (q-ROFs) (Khan et al., 2020); Multi-criteria decision-making (MCDM)	Engagement	B
Esteves and Barclay (2011)	Australia	Mining, oil and gas	Mixed methods	desktop research; semi-structured interviews	Partnership, leadership transfer	B
Fraser and Kunz (2018)	Peru, Mongolia	Copper, silver, gold	Mixed methods (exploratory case studies)	in-field observation; qualitative interviews; review of publicly available documents	Partnership empowerment, engagement	A/B –
Grimshaw and Mates (2022)	UK	Coal	Qualitative (ethnography)	participant observation, semi-structured interviews and focus groups	Engagement, partnership, empowerment	B
Haigh et al. (2018)	UK	Coal	Quantitative	experiment (impact evaluation of fertilisation treatment), citizen science	Engagement	B
Himley (2010)	Peru	Gold	Qualitative	Interviews, focus groups, and participant observation; critical geography	Consultation, partnership	B
Hirons et al. (2014)	Ghana	Gold	Mixed methods	Critical realist philosophy; methods deriving from natural science and reflexive and interpretive data collection	Consultation (only with the village chief, no adequate representation)	B
Hodgkins (2016)	Canada	Oil sands	Qualitative	Semi-structured interviews	Consultation, engagement	B
Holley and Mitcham (2016)	USA	Gold, copper, molybdenum	Qualitative	Interviews	Consultation, engagement, partnership	B
Jardine et al. (2013)	Canada	Gold	Qualitative	Interviews	Consultation, partnership, engagement	B
Keenan et al. (2016)	Australia	Not specified	Qualitative	Interviews	Consultation, engagement, empowerment	B
Kivinen et al. (2018)	Finland	Iron, Copper	Mixed methods	Public Participation Geographic Information System (PPGIS) approach	Empowerment	B
Meadows et al. (2019)	Australia	Not specified	Qualitative	Interviews, literature review	Consultation, engagement, partnership, leadership transfer	B
Menton et al. (2021)	Brazil	Gold	Qualitative (case studies)	Observations of social media and messaging apps, interviews	Engagement, empowerment, leadership transfer	B

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(continued)

Study	Country	Type of resources	Research design	Methods	Types	Positionality ^a
Missens et al. (2007)	Canada	Diamond	Qualitative	Interviews	Consultation, engagement, partnership, leadership transfer	A/B
Monosky and (2021)	Canada	Bauxite, coal, iron ores	Qualitative	Semi-structured interviews, policy analysis	Consultation, engagement, partnership, empowerment	B
Mukarrom et al. (2022)	Indonesia	Coal	Quantitative	Cost-benefit analysis, rate of return, plasma system analysis	Partnership, empowerment	B
Nagisetty et al. (2020)	USA	Copper	Quantitative	Closed-ended survey	Engagement	B
O'Brien et al. (2021)	Colombia	Gold	Mixed methods	Qualitative and semi-structured interviews; surveys	Engagement, empowerment	B
Palmer et al. (2010)	UK	Coal	Qualitative	Interviews; review of relevant literature and documentary evidence	Partnership, empowerment, leadership transfer	B
Phenrat (2020)	Myanmar	Coal	Qualitative	Community citizen science approach; field investigations	Engagement, empowerment	B
Prno et al. (2021)	Canada	Gold	Qualitative (program effectiveness evaluation)	Community research initiatives, meetings, and various audio, visual, and written media method	Engagement, partnership	A
Ramirez-Andreotta et al. (2016)	Nigeria	Oil	Qualitative	Evaluation of public sources, observations during meetings and engagement activities	Engagement, partnership	B
Rich et al. (2015)	UK	Coal	Mixed methods	Participatory GIS (PGIS) workshops and on-site rapid appraisal GIS (RAP-GIS); plant surveys using quadrats; collation and habitat classifications using iSpot, an online species identification tool	Engagement	B
Rosa et al. (2020)	Australia	Bauxite	Qualitative	Interviews; document analysis (environmental impact studies & monitoring reports); literature review	Consultation, engagement	B
Rosa et al. (2018)	Brazil	Bauxite	Quantitative	Ecosystem services assessments via semi-structured joint interview & workshop; document analysis	Consultation, engagement	B
Saxinger and First Nations (2018)	Canada	Gold	Qualitative	Community-based participatory research (CBPR), interviews, participant observation, field trips	Engagement, partnership	B
Schwartz et al. (2021)	Colombia	Gold	Qualitative	Semi-structured interviews, surveys, site visits	Engagement	B
Setiawan et al. (2021)	Indonesia	Coal	Quantitative	Cost benefit analysis, impact analysis	Partnership	B
Simon and Clarke (2016)	Australia	Not specified	Mixed methods	Survey, semi-structured interviews	Consultation, engagement, partnership	B
Sosa et al. (2017)	Peru	Hydro	Qualitative	Fieldwork (participatory observation, semi-structured, open interviews, participation in community assemblies & regional forums); review of literature and secondary sources (e.g., archives, news)	Consultation, engagement, empowerment	B
Stephenson and Wray (2005)	UK	Coal	Qualitative	Focus-group, interviews, participant observation	Partnership	B
Stough-Hunter et al. (2014)	USA	Hydro	Quantitative	Survey	Engagement, empowerment, leadership	B
Torso et al. (2020)	USA	Lead, zinc, silver	Qualitative	Participatory action research and Indigenous research methodologies frameworks	Consultation, engagement, partnership, leadership transfer	B
Withanachchi et al. (2018)	Georgia	Copper	Mixed methods	Survey, interview	Engagement	B

^a A = researchers undertaking the community engagement on behalf of the mining companies; B = researchers reviewing community engagement undertaken by mining companies).

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