

Shaping the Future of Our Landscape_ Community Views on Repurposing Abandoned Mine Lands

Authors: Epiphanie Murorunkwere¹, Denis Uwimpuhwe¹, Theophile Bimenyimana², Magalie Ntahokaja³,

Affiliation:

¹Department Environmental studies, University of Lay Adventists of Kigali (UNILAK)
KK 508 St Remera, Kigali, Rwanda P.O. Box 6392

²Department of Mining, School of Mining and Geology, College of Science and Technology, University of Rwanda, P.O. BOX 3900, Kigali Rwanda.

³Department of Geology, School of Science, College of Science and Technology, University of Rwanda, P.O. BOX 3900, Kigali Rwanda.

Corresponding author: Email: epiphanydudu@gmail.com , bimtheo98@gmail.com

Abstract

Protecting the environment is a shared responsibility. In the current global context, climate change and environmental protection have become central concerns. One of the ways the environment can be severely degraded is through mining operations.

This study aimed to assess community perspectives on the rehabilitation of abandoned mine sites. Data were collected through survey and questions focused on appropriate management strategies for such sites. The findings revealed that the community places significant trust in regulatory institutions and mining companies, holding them primarily responsible for managing abandoned mine sites.

Key aspects were explored to determine the most effective strategic approach to abandoned mine management: Governance, A large proportion of respondents expressed confidence in government institutions responsible for regulating and planning mining sector development. The community also advocated for transforming abandoned mines into sites for ecological restoration, ideally with economic co-benefits.

Funding for rehabilitation, there was a strong consensus that mining companies should bear the financial responsibility for rehabilitation efforts. Additionally, community members expressed a willingness to actively participate in initiatives aimed at restoring abandoned mine sites, reflecting a collaborative approach to environmental stewardship.

These insights underscore the importance of multi-stakeholder engagement combining regulatory oversight, corporate accountability, and community participation to achieve sustainable rehabilitation outcomes.

Key word: Abandoned Mine site rehabilitation, community perspective, Environmental rehabilitation, Multi-stakeholder engagement, Regulatory trust

1. Introduction

The global discourse on climate change and environmental protection has never been more urgent. Despite ongoing advocacy and growing awareness, activities that contribute to environmental degradation continue to persist. In this context, mining stands out as one of the most impactful activities, often causing significant and lasting harm to ecosystems.

This study draws on a community-based survey designed to assess two key dimensions: the community's willingness to contribute to environmental protection, and their level of awareness regarding the environmental impacts of mining activities. The survey findings reveal that the community not only understands its role in environmental stewardship but also holds constructive ideas that could be harnessed to support the rehabilitation of abandoned mine sites. By integrating local insights with targeted interventions, there is significant potential to turn degraded mining areas into opportunities for ecological restoration and sustainable community benefit.

2. Background

It is known that the mining and extractive industry plays an important role in different sectors of the society, creates jobs and it is necessary for the world development. Nevertheless, due to adverse environmental impacts such as water, underwater and air pollution, deforestation, biodiversity degradation, and surface deformation, mine rehabilitation is carrying out at the end of mines life-cycle as one a stage more of it (Owen & Kemp, 2017a).

As an overall idea it is understood by land rehabilitation, the process of attempting to restore an area of land back to its natural state after it has been damaged or degraded, making it safe for wildlife and flora, as well as humans. It refers to any enhancement in regard with to ecosystem functioning and structure, independent of whether full restoration is achieved or not. (Campos Alfonso, 2019) (Mentis, 2020a) In contrast, restoration is defined as a complete restitution of ecosystem structure after degradation beyond its natural resilience threshold.

But the term mining restoration refers concretely to the rehabilitation of the area affected by the mining activities. Including recovering the landscape previously located in the area, and considering safety and health factors for nearby populations, guaranteeing a healthy and adequate state for the recovery of lost biodiversity (Romanelli et al., 2015). Even if, there is no an exactly number of abandoned mines per region, it is known that the industry is forcing the

environment to their limit, which has side effects for the flora and fauna and for the humans too. So that it is necessary to sort out this environmental situation in order to avoid serious consequences. For this reason, this research will try to clarify the problems and difficulties that mining restoration entails, together with the possible steps to follow in order to prioritize the work during the process

In spite of the fact that, recovering the land affected is the most important part of the rehabilitation process, it also has other convenient side effects in regard to the society, since is known that most community opposition to mining (Mentis, 2020b), is focused on the long-term impacts of mining activities in the environment. But due to this rehabilitation practices, is improving the public's perception of the mining industry. Nevertheless, there is still a lot work to do in this subject-matter, since there are so many abandoned sites which have not been rehabilitated yet. Despite this environmental emergency situation, there is no international-wide inventory of abandoned sites due to the lack of information provided from the companies. However, is already known an approximate number of abandoned sites per region, which provide an overall idea of the abandoned mine sites worldwide.

According with The New South Wales Department Mineral Resources, there are around 500 sites in Australia, but it is not a comprehensive list of all the sites (Mining, Minerals and Sustainable Development, April 2002). In Canada there are some variable inventories which gather information about 10139 abandoned mines approximately, but most of them are not assessed. Moreover, the British Geological Survey of abandoned mines data, from the Metallogenic Map of Britain 1996, listed 155 abandoned mines, and in the US is known that there are a large number of abandoned mines due to the legacy of the 16th century, the beginning of the industrial age. It is estimated that there is over than 557,5 abandoned hard rock mines in 32 states, such as in Arizona where is suggested by the State Mine Inspector's Office that there are as many as 27000 abandoned mines features in the State.

South Africa also has many abandoned mines due to a long mining history, these include 134 abandoned asbestos mines and 400 asbestos dumps that are still contributing to the constant flow of asbestos dust to the surrounding areas creating a health hazard. In the European countries such as Ireland, the Environmental Protection Agency (EPA) has identified five sites that are or have the potential to cause environmental problems, and in Sweden is known a list of over 1000 abandoned mines, but only 70 environmentally significant. In addition, Japan has an approximately number of 5500 abandoned mines, specified by the national survey, and in

Chile a survey by the National Geology and Mining Service in 1989/1990 found, that in northern and central Chile over 50% of the 665 tailings storage facilities studied had been abandoned without any clean-up or rehabilitation (Bell & Donnelly, 2006a). Due to the approximately number of mines found it is congested that, and look upon more abandoned sites than the approximate number, it is necessary to rehabilitate the land affected by mining activities.

So as to recover the flora and fauna, and decrease the visual impact of the area, bring a new use to the land considering the nearby populations, and improve the public's perception of the mining industry, since it is a crucial part for the world society development. However, it is a long and hard procedure which needs specific studies of the affected area, and the environment of the place surroundings including people needs. But not all parts of the rehabilitation process have benefits, that is why it is necessary to consider the land rehabilitation advantages and disadvantages, before start the process.

2.1 Heavy Metal Contamination

Heavy metal contamination represents the most pervasive environmental threat associated with abandoned mine sites. A systematic review by (Muhammad et al., 2024) identifies arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), zinc (Zn), and mercury (Hg) as the primary contaminants of concern, noting their persistence in environmental media for extended periods. These metals originate from exposed tailings piles, waste rock, and untreated mine drainage, mobilizing through wind and water erosion into surrounding ecosystems.

The mechanisms of metal mobilization are complex and site-specific. (Lodariya et al., 2025a) documents how mining practices such as mercury amalgamation introduce long-term pollutants that remain bioavailable decades after cessation of operations. The review emphasizes that heavy metals brought to surface during extraction remain in tailings piles, where weathering and acid mine drainage facilitate continued mobilization into water bodies.

2.3 Phytoremediation and Dendroremediation

Dendroremediation, a specialized form of phytoremediation using trees, has emerged as a particularly promising approach. (Mukherjee et al., 2025) provide a comprehensive review of dendroremediation for abandoned mining sites and brownfields, concluding that tree-based

remediation not only manages degraded land but also offers aesthetic improvements, attracts biodiversity, and restores environmental sustainability. The authors highlight that dendroremediation provides "transparent and demonstrable use of natural processes," addressing concerns about greenwashing in environmental management.

The advantages of trees over herbaceous plants include deeper root systems capable of accessing subsurface contaminants, greater biomass for contaminant uptake and storage, longer growing seasons, and provision of ecosystem services including carbon sequestration and habitat provision. However, (Mukherjee et al., 2025) caution that successful dendroremediation requires careful species selection based on site-specific conditions, contaminant profiles, and climate considerations, noting distinct challenges between Global North and South contexts

2.4 Water quality degradation

Acid mine drainage (AMD) represents a particularly challenging legacy of abandoned mines. When sulfide minerals, particularly pyrite, are exposed to air and water, oxidation produces sulfuric acid, lowering pH and mobilizing heavy metals from surrounding rock. Scientometric analysis by (Wang et al., 2026) identifies acid mine drainage as one of eight primary research clusters in abandoned mine restoration literature, reflecting its centrality to the field.

Surface water and groundwater contamination pathways are interconnected. (Ghosh et al., 2025) note that abandoned open pit mines can serve as sources of pollution, with contaminants leaching into surrounding soil and water bodies, causing ecological damage and human health risks. The review emphasizes that despite contamination risks, these sites also offer large surface areas that, if properly remediated, could be repurposed for water management.

3. Research Methodology

The primary objective was to gain insight from communities living around abandoned mine sites regarding how these areas could be rehabilitated to address the environmental challenges associated with mining activities. To achieve this, the survey questions were carefully designed to identify the most suitable approaches that could be adopted either by government institutions responsible for mining oversight or by private mining different Mining institutions and companies were interviewed.

The survey began by assessing community awareness of the existence of abandoned mines. Respondents were asked, “Are you aware of the presence of abandoned mine lands in our area? What is the current state of these abandoned mine lands?” This line of inquiry helped determine whether the community actively monitors hazardous conditions in their surroundings.

To explore potential post-rehabilitation uses, participants were asked, “Imagine the abandoned mine lands in our area could be safely cleaned up and reused. Which of the following potential uses would you most support? You mentioned supporting [above]. What is the main reason for this preference?” This question aimed to uncover whether the community sees value and opportunity in transforming abandoned mines.

Understanding the level of community willingness to engage in rehabilitation efforts was another key focus. Participants were asked, “If a mining company proposed a plan to repurpose an abandoned mine site, would you be willing to attend a public meeting to show your support?” In addition, to assess readiness for shared financial responsibility, the survey included, “Sometimes, repurposing requires public funds. Would you support a small increase in local sales tax or municipal fees (e.g., 100,000 Rfw per year) specifically dedicated to cleaning up and repurposing abandoned mines?” This ensured that any future rehabilitation project would have a foundation of community ownership and accountability.

Finally, to identify which stakeholders the community trusts to lead and regulate such efforts, respondents were asked, “Who do you trust most to manage the repurposing of an abandoned mine site?” This question helped clarify perceptions of responsibility and the preferred leadership role in managing rehabilitation processes.

By integrating these targeted questions with direct community feedback, the study was able to draw informed conclusions on the most effective approaches to managing and transforming abandoned mine sites for economic use all while ensuring compliance with environmental protection standards.

4.Results

After conducting a survey aimed at identifying the strategic methods to be adopted for managing abandoned mines, we were able to gather valuable feedback that now serves as a foundation for informed decision-making.

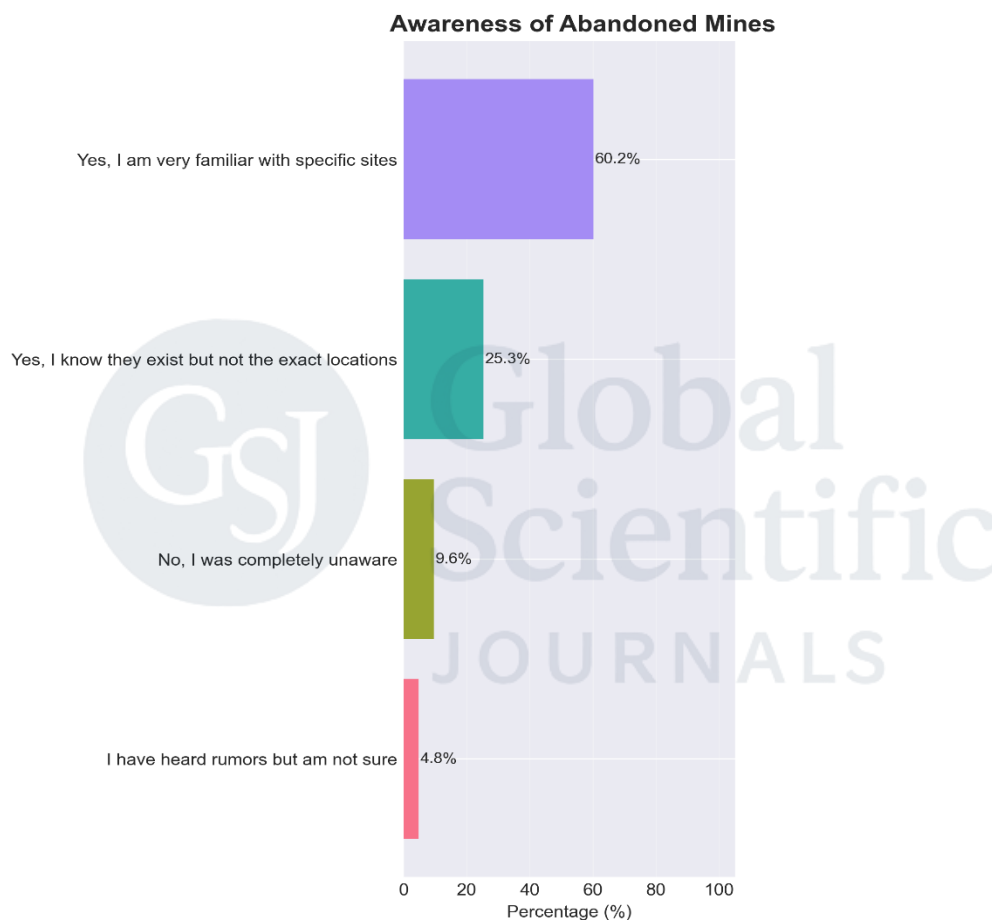


Fig 1: Awareness of the community about abandoned Mines site

The majority of participants in this study have backgrounds connected to the mining sector, including individuals who have previously worked with mining companies, those currently employed in the sector, mining students, and public servants working in mining or related fields. Regarding awareness of abandoned mines in the area, 60.2% of respondents reported being familiar with such sites (**Fig 1**). A further 25.3% acknowledged the existence of abandoned mines but had no direct experience with them. Meanwhile, 9.6% were completely

unaware of any abandoned mines in the area, and 4.9% expressed uncertainty about their existence.

Support for Tax/Fee Increase

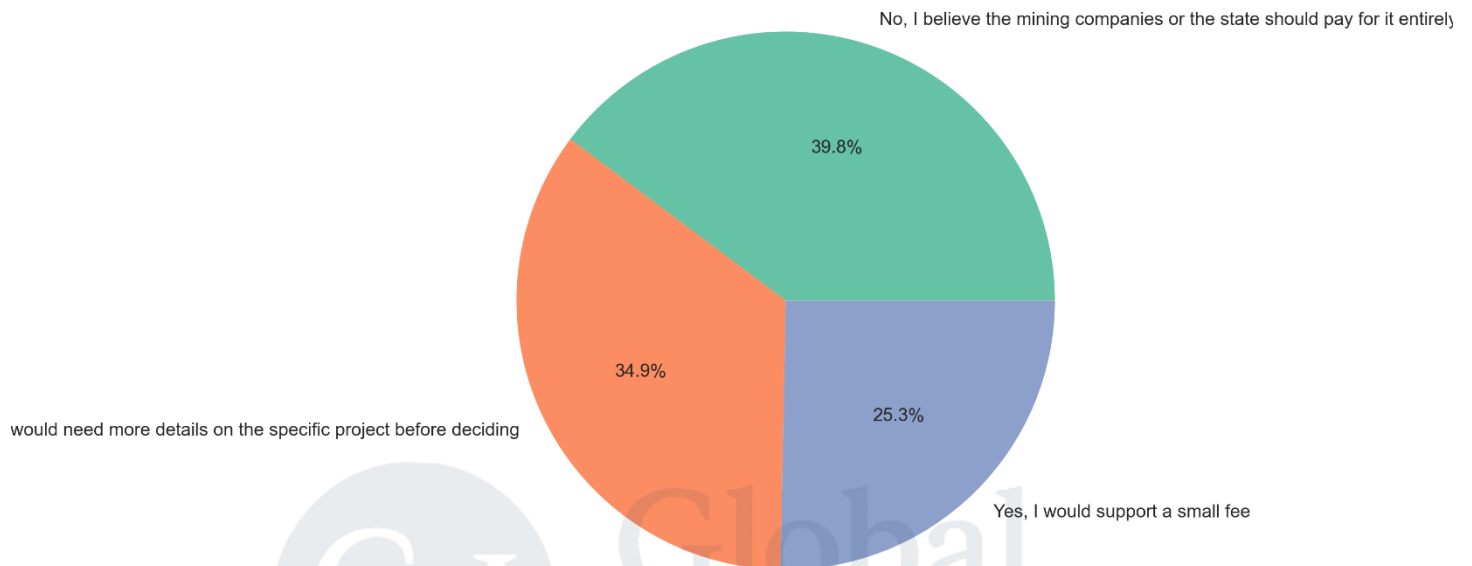


Fig .2: Illustrates the community's willingness to provide financial support for projects related to the rehabilitation of abandoned mine sites

Regarding financial contributions toward rehabilitation efforts, 39.8% of respondents indicated they would support such initiatives but firmly believed that mining companies should bear the full cost. Meanwhile, 34.9% found the idea of financial support to be convincing, though the preferred mechanism was not specified, while 25.3% expressed willingness to contribute through a small fee (**Fig 2**).

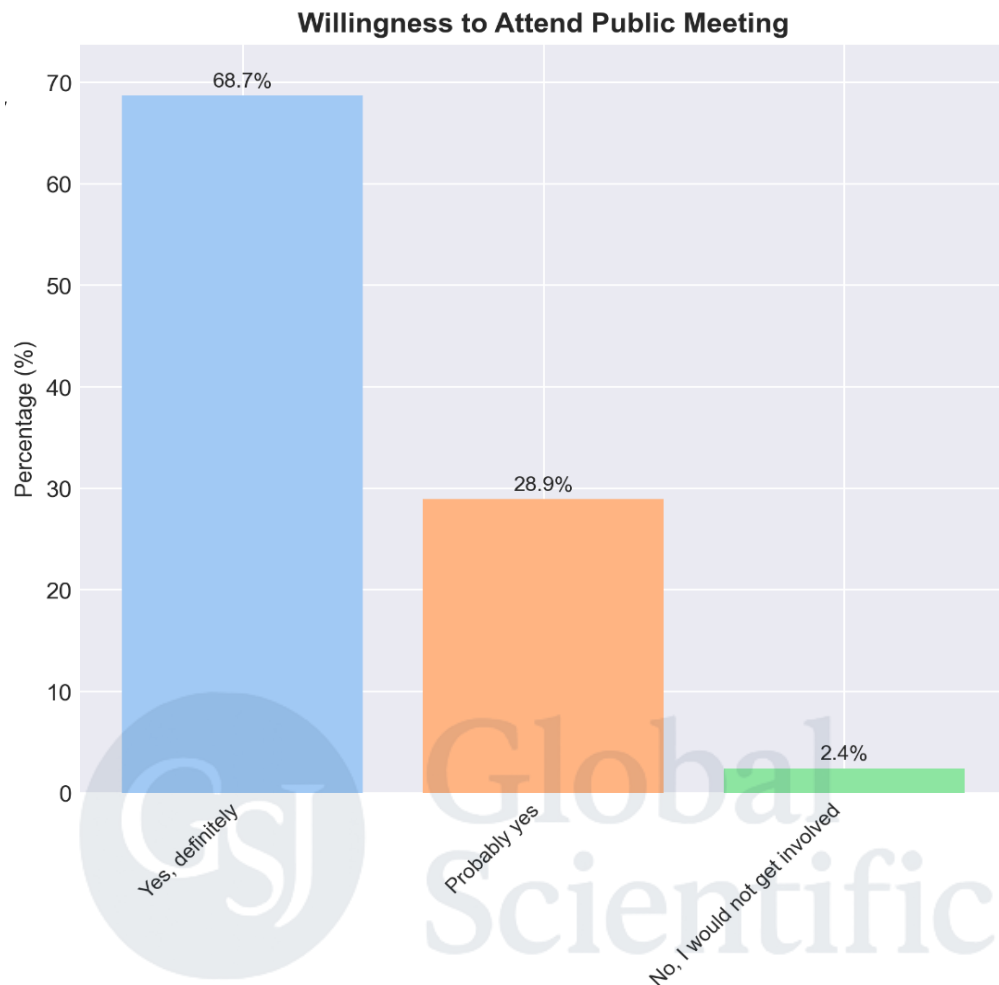


Fig. 3: Community willingness to participate in discussions aimed at addressing the situation of abandoned mine sites.

In addition, community willingness to engage in discussions on mine site rehabilitation was notably high. As shown in (**Fig 3**), 68.7% of respondents expressed a clear willingness to attend discussions related to mine protection, 28.9% indicated they might attend if their schedule permitted, and only 2.4% declined to be involved.

These findings suggest that managing abandoned mine sites may not require excessive effort, given the community's demonstrated willingness to participate in rehabilitation processes. This level of engagement provides a strong foundation for collaborative approaches involving both community members and relevant stakeholders.

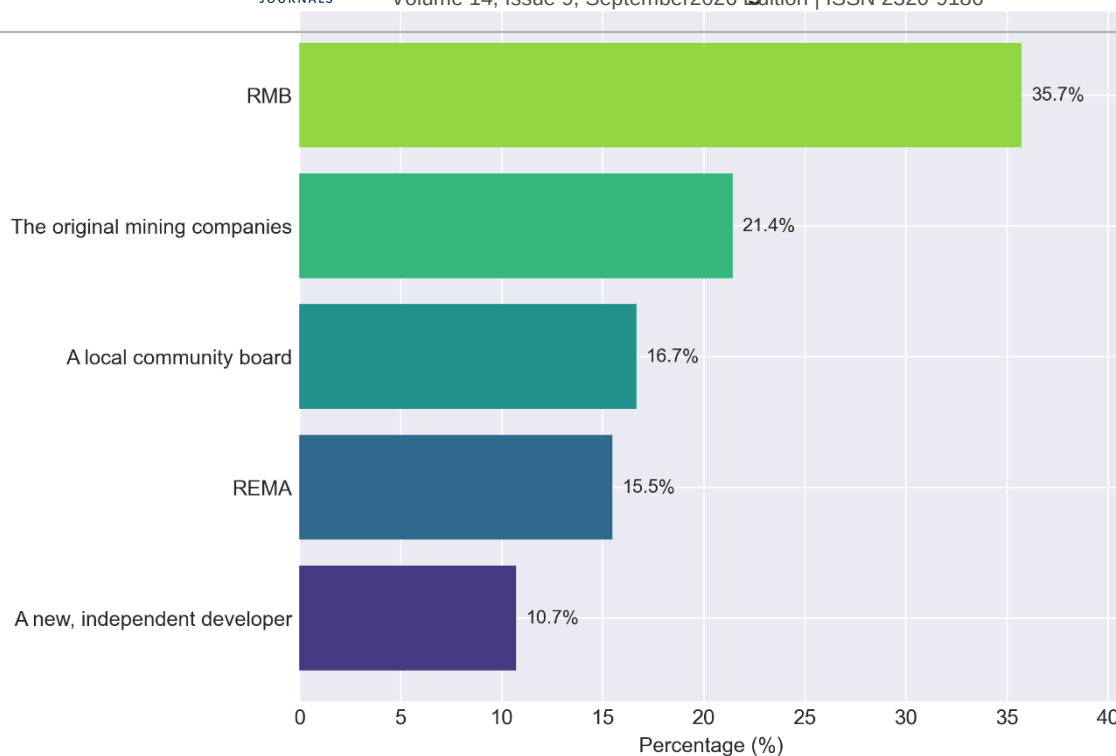


Fig. 4: Community preferences regarding trusted entities to lead the management and rehabilitation of abandoned mine sites

Regarding which entity the community believes should take responsibility for managing abandoned mine sites, a range of perspectives emerged, as illustrated in (Fig 4). The largest proportion of respondents, 35.7%, indicated that the Rwanda Mines, Petroleum and Gas Board (RMB) should take the lead. A further 21.4% proposed that mining companies should bear full responsibility for controlling abandoned mine sites, while 16.7% expressed trust in local community boards to manage such sites. Additionally, 15.5% of respondents believed that the Rwanda Environment Management Authority (REMA) should be responsible for the protection of abandoned mine sites, and 10.7% suggested hiring a private independent company to regulate and monitor the ongoing management of these sites.

Overall, the feedback indicates a clear preference for existing government institutions with a mandate to control and regulate mining activities to take the lead in monitoring abandoned mine sites, proposing pathways for rehabilitation, and addressing any associated challenges.

5. Discussion

The finding that 60.2% of respondents reported familiarity with abandoned mine sites in their areas, with an additional 25.3% acknowledging their existence despite lacking direct experience, suggests a moderately high level of community environmental awareness. This exceeds the general awareness levels documented in comparable developing economy contexts. For instance, (Onah et al., 2023) in Ghana's mining regions found that only approximately 45% of communities living near abandoned mines demonstrated clear awareness of these sites' presence and associated risks.

The relatively higher awareness in Rwanda may be attributed to several factors. First, as noted in our methodology section, a substantial proportion of participants had direct or indirect connections to the mining sector, including current employees, former workers, and students in mining-related fields. This finding aligns with (Owen & Kemp, 2017b) observation that communities with economic ties to extractive industries tend to develop heightened environmental monitoring capacities. Second, Rwanda's post-conflict reconstruction period has emphasized environmental governance as a national priority, potentially increasing general environmental literacy across sectors (REMA, 2020).

However, the 9.6% of respondents who were completely unaware of abandoned mines in their vicinity, despite presumably living near such sites, raises concerns about environmental risk communication. This finding mirrors the "environmental blindness" phenomenon described by (Lodariya et al., 2025b), where communities living adjacent to degraded landscapes may normalize environmental damage to the point of non-recognition. The 4.9% expressing uncertainty further suggests that official inventories and public awareness campaigns may need strengthening, a challenge noted internationally, as (Bell & Donnelly, 2006b) documented similar uncertainty rates ranging from 3% to 12% across Australian and Canadian mining communities.

The 34.9% of respondents who found financial support "convincing but unspecified" and the 25.3% willing to pay modest fees indicate a pragmatic recognition that full corporate funding may not always materialize. This aligns with (Zhang et al., 2026), who documented that in many jurisdictions, mining companies become insolvent or dissolve before rehabilitation occurs, leaving communities and governments to bear the residual costs. The willingness of approximately one-quarter of respondents to accept a small local tax increase (100,000 Rwf annually, approximately 75 USD) suggests an emerging social license for innovative financing mechanisms, including public-private-community partnerships.

6. Conclusion

To provide decision-makers with a clear overview of the project, the following recommendations are proposed based on survey findings. According to the survey, 35.7% of respondents trust the Rwanda Mines, Petroleum and Gas Board (RMB), while 16.7% prefer community boards. To enhance coordination and effectiveness, it would be worthwhile to establish a Multi-Stakeholder Steering Committee. This committee should be led by the RMB for overall coordination and include representatives from the Local Community Board, the Rwanda Environment Management Authority (REMA) for environmental oversight, and mining companies to provide technical expertise.

In transforming the abandoned mine site, priority should be given to ecological restoration, followed by recreation and tourism, and then commercial or industrial use. Regarding funding strategies, mining company contributions should form the largest share, supplemented by government grants and subsidies, community contributions through modest fees, and private sector partnerships.

Additionally, the research proposes the following regular activities: establishing a Community Advisory Board with quarterly meetings, creating a digital platform for ongoing feedback, holding annual public forums with clear action items, and developing educational programs to raise awareness about the benefits of mine repurposing. These initiatives aim to ensure proper management and effective handling of issues related to abandoned mine sites.

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