


Assessing Environmental and Social Safeguard Compliance in Zambia's Mining Sector: A Case Study of Zambia Gold Company Mine

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How to cite this paper: Kaonda, M.K.M. and Neil, L.W. (2026) Assessing Environmental and Social Safeguard Compliance in Zambia's Mining Sector: A Case Study of Zambia Gold Company Mine. *Journal of Environmental Protection*, 17, 473-498. <https://doi.org/10.4236/jep.2026.176023>

Received: May 21, 2026

Accepted: June 15, 2026

Published: June 18, 2026

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Abstract

Environmental, Social and Governance requirements have become increasingly important in mining governance, but their effectiveness depends on whether formal commitments are translated into operational practice, disclosed to affected stakeholders, independently monitored, and connected to corrective action. This article examines the implementation of environmental and social safeguards at Zambia Gold Mine, specifically Kansenseli Gold Mine, as a case study of ESG operationalisation in Zambia's mining sector. The article addresses a central problem in extractive-sector governance: the gap between documentary compliance, represented by environmental assessment instruments, approval conditions, management plans and regulatory obligations, and substantive safeguard performance as experienced by stakeholders. The study is based on a pragmatic single-case-study design combining documentary analysis, semi-structured key informant interviews, focus group evidence, and a limited community perception survey. Evidence is analysed across three ESG dimensions: environmental management, social safeguards, and governance accountability. Institutional theory, stakeholder theory and political economy are used as complementary analytical lenses to explain why implementation gaps may persist despite the existence of formal safeguard systems. The findings indicate that safeguard commitments at Zambia Gold Mine are formally documented and partially operationalised through monitoring procedures, consultation processes and regulatory oversight. However, implementation remains uneven. Environmental monitoring is reported to occur, but monitoring results are not consistently disclosed to affected communities in accessible formats. Community engagement structures exist, but participation is mediated heavily through traditional leadership and does not always produce continuous, inclusive dialogue. Governance systems are formally present, but constrained by regulatory capacity limitations, fragmented account-

ability arrangements, limited public disclosure and the structural tensions associated with state-linked ownership. The article concludes that ESG performance in Zambia's mining sector cannot be evaluated through documentary compliance alone. Strengthening safeguard effectiveness requires transparent disclosure of monitoring results, continuous stakeholder engagement, accessible grievance mechanisms, performance-based ESG indicators, stronger regulatory capacity and clearer institutional separation between state ownership interests and regulatory oversight. The case contributes to mining policy debates by showing that ESG implementation gaps arise not from the absence of formal safeguards, but from weaknesses in the implementation chain linking commitments, operational practice, disclosure, participation, verification and corrective action.

Keywords

ESG, Environmental and Social Safeguards, Zambia, Mining Governance, Resources Policy, State-Linked Mining, Community Engagement, Transparency, Safeguard Implementation, Regulatory Capacity

1. Introduction

Mining remains central to Zambia's economic development. It contributes to export earnings, fiscal revenue, employment, infrastructure development and local economic activity. In addition, mining generates environmental and social risks that require effective governance. These risks include land disturbance, water contamination, waste and tailings management challenges, occupational health and safety concerns, biodiversity loss, pressure on local services, disputes over land access, community grievance issues and unequal distribution of benefits and burdens. Mining governance is therefore not only a technical issue of production, licensing and environmental management. It is also a question of accountability, legitimacy, institutional capacity and sustainable development.

In recent years, Environmental, Social and Governance requirements have become increasingly important in the mining sector. ESG has moved beyond a narrow investor-reporting vocabulary and now shapes how governments, regulators, lenders, companies, communities and civil society assess the legitimacy and performance of extractive operations. Therefore, in principle, ESG should connect corporate policy commitments, environmental and social management systems, public disclosure, stakeholder engagement, grievance mechanisms, governance arrangements and corrective action. In practice, however, ESG may remain weak if it is reduced to documentary compliance, public-relations language or reporting without sufficient evidence of implementation [1] [2].

This study examines the implementation of environmental and social safeguards at Zambia Gold Mine, specifically Kansenseli Gold Mine, as a case study of ESG operationalisation in Zambia's mining sector. The article does not ask

whether formal environmental and social documentation exists. Rather, it asks whether documented commitments are translated into operational practice, monitored by competent authorities, disclosed to affected stakeholders and experienced by communities as meaningful protection. This distinction is important because mining projects may possess environmental assessment documents, environmental project briefs, environmental and social management plans, approval conditions, monitoring obligations and stakeholder engagement procedures while still facing gaps in implementation, transparency, participation and accountability.

The problem addressed in this article is the gap between formal safeguard commitments and substantive safeguard performance. Formal commitments are contained in instruments such as Environmental Impact Statements, Environmental Project Briefs, approval conditions, management plans, permit requirements, monitoring obligations and corporate policies. Substantive performance refers to whether these commitments are implemented, monitored, disclosed, corrected and recognised by affected stakeholders as credible and responsive. In the thesis, this is framed as the gap between safeguard commitments documented in ESIA or EPB instruments, permit conditions and related management obligations, and the actual environmental, social and governance performance of mining operations [3].

This distinction is especially relevant in the Zambian mining sector. Zambia has a formal legal and institutional framework for mining regulation and environmental management. Yet formal regulation does not automatically ensure effective implementation on the ground. In many mining jurisdictions, including in parts of Africa, the existence of environmental approval processes, permits and management plans may coexist with weak monitoring, limited disclosure, poor consultation, low community trust and fragmented institutional accountability. In such cases, the central governance question is not whether safeguards exist in documentary form, but whether they function as instruments of prevention, mitigation, accountability and remedy [4] [5].

Zambia Gold Mine provides a useful case through which to examine this issue. The mine is associated with Zambia's broader ambition to diversify mineral production and strengthen state participation in mining. This makes the case significant not only as an operational site, but also as a governance site at the intersection of environmental regulation, mineral development policy, state-linked ownership, local livelihoods, traditional authority, community expectations and public accountability. The case offers analytical depth rather than statistical representativeness.

The state-linked character of the operation is analytically important. State participation in mining may support national development objectives, local value creation, employment and mineral-sector diversification. It may also create expectations of stronger public accountability because the operation is linked to national development policy. However, state-linked mining may also generate governance

tensions where the state is simultaneously owner, promoter, regulator and policy authority. These overlapping roles do not necessarily result in weak safeguards, but they create structural risks relating to regulatory independence, public disclosure, accountability and enforcement credibility. For this reason, the case contributes to broader debates in minerals policy concerning the governance of state-linked extractive operations.

The article makes three contributions. First, it develops the distinction between documentary compliance and substantive safeguard performance as a way of analysing ESG implementation in mining. Second, it provides a mine-level case study of safeguard implementation in Zambia's gold sector, where empirical ESG governance research remains limited compared with copper and large-scale multinational mining. Third, it shows how implementation gaps arise from the interaction of regulatory capacity constraints, information asymmetry, participation limitations, fragmented accountability and state-linked ownership dynamics [1] [6].

The article is organised as follows. Section 2 develops the conceptual framework, distinguishing documentary compliance from substantive safeguard performance and explaining the relevance of institutional theory, stakeholder theory and political economy. Section 3 presents the case context and methodology. Section 4 analyses findings across the environmental, social and governance dimensions. Section 5 discusses why ESG implementation gaps persist and what they reveal about mining governance in Zambia. Section 6 proposes practical recommendations for mine management, regulators, government policy actors and community systems. Section 7 concludes by outlining the article's contribution to mining policy and ESG governance debates.

2. Conceptual Framework: From Documentary Compliance to Substantive Safeguard Performance

2.1. ESG, Safeguards and the Implementation Problem

Environmental, Social and Governance has become an important framework for assessing responsible mining. In the mining sector, ESG covers a broad set of issues: environmental management, pollution control, biodiversity protection, land rehabilitation, water management, worker safety, community health, consultation, grievance mechanisms, human rights, benefit sharing, transparency, governance structures, anti-corruption, regulatory compliance and accountability. However, because ESG is broad, it can also become imprecise. Without operational indicators, monitoring systems, disclosure processes and corrective mechanisms, ESG risks becoming a label rather than a system of accountability.

Environmental and social safeguards provide a more operational entry point for assessing ESG in mining. Safeguards include environmental assessment, mitigation planning, monitoring, stakeholder engagement, grievance mechanisms, rehabilitation planning, labour protections, community health and safety measures, pollution controls and reporting obligations. They are the mechanisms through

which broad ESG expectations are translated into mine-level commitments. For this reason, the effectiveness of ESG in mining can be assessed partly by examining whether safeguard instruments are implemented in practice.

The central issue is that safeguards may exist in formal documentation without functioning effectively. A mine may have an Environmental Impact Statement, an Environmental Project Brief, an Environmental and Social Management Plan, a stakeholder engagement process and a grievance mechanism. It may submit reports to regulators and maintain records of monitoring activities. These elements are important and should not be dismissed. Yet they do not, by themselves, prove that safeguard performance is effective. Effectiveness depends on whether these commitments are translated into operational controls, whether monitoring results are verified, whether information is disclosed, whether communities understand their rights, whether grievances are addressed and whether corrective action follows identified problems [3].

This article therefore distinguishes between documentary compliance and substantive safeguard performance. Documentary compliance refers to the existence of formal regulatory, procedural and management documentation. It includes permits, approval conditions, environmental assessment reports, monitoring records, policies, management plans, inspection records, consultation minutes and grievance procedures. Documentary compliance is necessary because it establishes the formal obligations and evidence base for governance. However, it is not sufficient.

Substantive safeguard performance refers to the actual functioning of safeguards. It concerns whether commitments are implemented, monitored, disclosed, corrected and experienced by affected stakeholders as credible. It includes the quality of environmental monitoring, the accessibility of information, the inclusiveness of consultation, the responsiveness of grievance systems, the independence of oversight, the adequacy of corrective action and the extent to which stakeholders can verify what is being claimed.

This distinction guides the analysis in the present study. The central problem is the gap between documented safeguard commitments and actual environmental, social and governance performance. The analysis therefore examines not only whether the mine possesses formal environmental and social documentation, but also whether those commitments are operationalized, monitored and experienced by affected stakeholders as meaningful protection.

2.2. The Safeguard Implementation Chain

To analyse ESG implementation, this article uses a six-stage safeguard implementation chain:

1) Formal commitments

These include laws, regulations, permits, environmental assessment instruments, approval conditions, management plans, policies and procedures. They establish what the operator is required or expected to do.

2) Implementation systems

These include operational roles, staff responsibilities, procedures, budgets, training, controls, mitigation measures and internal reporting systems. They determine whether formal commitments are translated into mine-level practice.

3) Monitoring and disclosure

These include environmental monitoring, inspections, compliance tracking, audit findings, corrective action records and public communication. They determine whether performance is measured and whether stakeholders can access meaningful information.

4) Stakeholder experience

This includes community perceptions, trust, grievance access, participation, experience of impacts, awareness of commitments and perceptions of fairness. It provides evidence on whether safeguards are recognised as meaningful by those affected.

5) Governance gap

This is the divergence between formal approvals and substantive performance. It may arise because of weak implementation, poor disclosure, limited participation, regulatory constraints or fragmented accountability.

6) Corrective action

This includes remedy, enforcement, management adjustment, institutional learning and performance improvement. It determines whether the safeguard system responds when gaps are identified.

The thesis already uses a similar analytical framework, linking formal commitments, implementation systems, monitoring and disclosure, stakeholder experience, governance gaps and corrective action. This model is useful because it avoids reducing compliance to documentation and allows ESG performance to be analysed as a sequence of linked governance functions.

The concept of an implementation chain also helps explain why safeguards may fail even where formal systems exist. A breakdown may occur at different points. Documents may be incomplete or inaccessible. Implementation systems may lack resources. Monitoring may be conducted but not disclosed. Communities may be consulted but not meaningfully included. Grievances may be recorded but not resolved. Regulators may have legal authority but insufficient capacity. Corrective actions may be identified but not completed. These weaknesses are not identical, but each affects the credibility and effectiveness of ESG performance.

2.3. Institutional Theory

Institutional theory helps explain why organisations adopt formal ESG and safeguard structures. Mining companies operate in environments shaped by laws, regulators, lenders, professional norms, industry standards, investors, civil society expectations and reputational pressures. These pressures encourage companies to adopt policies, management plans, reporting systems and compliance structures. Such adoption may improve performance, but it may also serve a legitimacy func-

tion [7] [8].

The concept of decoupling is particularly relevant. Organisations may adopt formal structures to demonstrate compliance while operational practices remain only partially aligned with those structures. In mining, decoupling may occur when environmental and social systems are documented but not embedded in operational decision-making; when consultation records exist but community participation remains limited; or when monitoring is undertaken but results are not disclosed in ways that affected stakeholders can understand [8].

In the Zambia Gold Mine case, institutional theory helps explain the coexistence of formal safeguard systems and implementation gaps. Environmental and social safeguard commitments are documented within Zambia's regulatory framework and mine approval conditions, and management systems and monitoring procedures appear to exist at operational level. At the same time, the evidence points to gaps in transparency, communication, consultation continuity and regulatory capacity.

Institutional theory therefore supports a nuanced interpretation. The presence of safeguard documents and systems should not be dismissed as meaningless. However, the existence of these systems does not automatically prove that ESG performance is effective. The question is whether formal systems are coupled to operational practice, disclosure, community recognition and corrective action.

2.4. Stakeholder Theory

Stakeholder theory is relevant because mining affects multiple groups with different interests, capacities and degrees of influence. Relevant stakeholders include mine management, regulators, employees, traditional authorities, local communities, affected households, artisanal miners, civil society organizations, investors and government policy actors. These groups do not have equal power, information, technical knowledge or access to decision-making [9].

In mining governance, stakeholder engagement is often formally required, but participation may be uneven. Consultation may occur through recognized local authorities, but this does not necessarily ensure that all affected groups are heard. Traditional leaders may provide important legitimacy and local governance continuity, yet reliance on traditional structures alone may underrepresent women, youth, marginalized households or those directly affected by environmental and livelihood impacts [9]-[11].

Stakeholder theory helps interpret why formal consultation structures may coexist with community dissatisfaction. It shifts attention from whether engagement occurred to whether engagement was inclusive, continuous, informed and responsive. It also highlights the importance of grievance mechanisms. A grievance mechanism is not effective merely because it exists on paper. It must be known, trusted, accessible, safe, timely and connected to remedy.

The thesis identifies community concerns regarding communication gaps, limited access to environmental information, weak grievance awareness and incon-

sistent feedback mechanisms. It also notes that engagement structures are mediated through traditional leadership systems, which may limit broader participation and reduce direct community influence over decision-making.

2.5. Political Economy

Political economy helps explain how resource governance is shaped by economic interests, state priorities, institutional incentives and power relations. Mining is rarely governed only through neutral technical regulation. It is linked to national development strategies, fiscal revenue, employment, foreign investment, industrial policy and local political expectations. These pressures influence how environmental and social safeguards are interpreted, prioritized and enforced [2] [7].

In state-linked mining operations, political economy becomes especially important. Public ownership or state participation may strengthen national control over mineral resources and support development objectives. It may also create expectations that mining revenues and production should contribute to national economic goals. However, where the state has both ownership and regulatory responsibilities, governance tensions may arise. Regulators may be expected to enforce environmental and social obligations independently while other state actors promote production, revenue and sector expansion.

This does not mean that state-linked mining is inherently weaker from an ESG perspective. It may create opportunities for stronger public accountability if disclosure, oversight and performance management are robust. However, state-linked mining requires careful governance design to ensure that ownership interests do not undermine regulatory independence or public trust.

The thesis identifies the state-linked nature of Zambia Gold Mine as analytically significant, noting that state ownership creates opportunities for public accountability and developmental alignment while also generating tensions between developmental objectives, production pressures and independent regulatory oversight.

3. Methodology

3.1. Case Context: Zambia Gold Mine and Kansenseli

Zambia Gold Mine, specifically Kansenseli Gold Mine in Northwestern Province, is used as a case study for analysing ESG implementation in Zambia's mining sector. The mine is relevant because gold mining in Zambia is associated with the country's broader effort to diversify mineral production beyond copper. Gold-sector development may also intersect with informal mining, local livelihoods, environmental sensitivity, customary authority and community expectations concerning benefit sharing. Company profile information and annual reports were used to contextualize the mine's ownership, operational background, and reopening trajectory [12] [13].

The case is also important because it is linked to state participation in mining. This makes it different from a purely private-sector mining case. The governance

environment includes not only mine-level management and regulatory oversight, but also public ownership expectations and national development objectives. This allows the article to examine how ESG implementation operates in a context where the boundaries between public development policy, ownership interests and regulatory accountability may be structurally complex.

The thesis identifies Kansenseli Gold Mine as the specific case and notes that the mine reopened in 2024 after closure in 2021. It also explains that Zambia Gold Mine was selected because it provides a relevant setting for analysing ESG implementation within a state-linked mining context, while offering analytical depth rather than statistical representativeness.

The case should therefore be positioned carefully. It is not a basis for statistical generalization across Zambia's mining sector. Rather, it is an analytically significant case that illustrates how safeguard commitments, operational systems, regulatory capacity, community participation and state-linked ownership interact in practice.

3.2. Research Design

The study uses a pragmatic single-case study design. This design is appropriate because ESG implementation in mining is a complex governance process that cannot be fully assessed through a single type of evidence. Documentary evidence shows formal commitments but does not necessarily show implementation quality. Interviews provide insight into institutional and operational practice but may reflect the perspectives of particular actors. Community evidence captures stakeholder experience, but may not establish technical causation. A case-study approach allows these forms of evidence to be compared and interpreted together.

The research is pragmatic because it is oriented toward practical explanation and reform. The objective is not to test a single abstract theory, but to understand how safeguard commitments are implemented and what reforms could strengthen performance. This orientation supports both empirical analysis and policy relevance.

The study adopted a pragmatic case-study approach that combined documentary analysis, semi-structured key informant interviews, focus group discussions, and a community perception survey to triangulate evidence across the environmental, social, and governance pillars. The documents reviewed included the Zambia Gold Company Profile [12], annual extract reports for 2020-2024 [13], the Mines and Minerals Development Act of 2015 (as amended in 2022) [14], the Environmental Management Act of 2011 [5], the Occupational Health and Safety Act of 2010 [15], ISO 45001:2018 [16], the Extractive Industries Transparency Initiative framework [6], the World Bank's Environmental and Social Framework [10], and the International Finance Corporation's Performance Standards on Environmental and Social Sustainability [3]. The study aimed to conduct 12 direct interviews and 16 focus group participants as part of the community-level inquiry. Participants were selected on the basis of their roles in the community and the

extent to which they were affected by mining activities. The interview sample comprised 29 key informants drawn from traditional leadership, religious leaders, youth representatives, artisanal miners, women, persons with disabilities, farmers, a council of elders representative, the Office of the District Commissioner, education and health representatives, civil society organizations operating in the area, staff from Zambia Gold Company (3), staff from ZCCM-Investment Holdings, and officials from the Zambia Environmental Management Agency (3). In addition, focus group discussions involved 24 participants, including women, youth, farmers, artisanal miners, and traditional and religious actors.

The data collection period spanned from June 2025 to March 2026, following the reopening of the mine. Accordingly, the findings reflect the post-reopening phase of operations. This timing is important for interpreting the results, as the mine had been operational again for only about one year, meaning that several ESG-related interventions were still at an early stage of development and implementation. The study focused primarily on Zambia Gold Company's ESG compliance. Although the case study centred on operations at Kansenseli, most interviews were conducted with personnel based at the Lusaka office, supplemented by an online interview with the ESG Compliance Officer based at Kansenseli. Meanwhile the focus group discussions and interviews with community members were conducted in Kansenseli.

3.3. Evidence Sources

The evidence base consists of four main sources.

For instance, documentary analysis was used to identify formal safeguard commitments. Relevant documents include environmental assessment instruments, approval conditions, management plans, monitoring requirements, regulatory documents, corporate information and publicly available materials. Documentary analysis is essential because it establishes the baseline against which implementation can be assessed.

Also, semi-structured key informant interviews were conducted with mine personnel, regulatory actors and knowledgeable stakeholders. These interviews provided insight into environmental monitoring, consultation processes, grievance mechanisms, regulatory oversight, institutional coordination and operational management.

Thirdly, focus group discussions and community-level evidence were used to understand stakeholder experience. These sources are important because safeguards are not only technical instruments; they also affect people's perceptions of trust, fairness, transparency and responsiveness.

Lastly, a limited community perception survey was used to provide descriptive evidence on awareness, consultation, perceived environmental and social impacts, trust and grievance access. The survey was not intended to generate statistically representative findings. Rather, it provided additional triangulation for the qualitative findings.

The thesis describes the methodological approach as structured around five objectives: mapping ESG-related commitments, assessing operational practice, identifying gaps, analysing governance and institutional factors, and developing practical recommendations.

3.4. Analytical Procedure

The analytical procedure followed an iterative thematic approach. Qualitative material from interviews, focus group discussions, documentary review and the community perception survey was organized under the three ESG dimensions used in the study: environmental management, social safeguards and governance accountability. The material was then used to identify recurring issues relevant to safeguard implementation, including disclosure of monitoring results, consultation processes, grievance awareness, regulatory oversight, institutional coordination, participation quality and corrective action.

These recurring issues were treated as initial analytical codes and compared across the different evidence sources. Related codes were then clustered into broader themes that captured recurring implementation patterns. Although the ESG framework shaped the overall structure of the analysis, the final themes were derived inductively from the material rather than imposed in advance. This allowed the analysis to move from descriptive accounts of specific incidents or perceptions to broader interpretations of how safeguard systems functioned in practice.

Triangulation was central to this process. Documentary evidence was used to establish formal commitments and procedural requirements, while interviews and focus groups provided evidence on operational practice and stakeholder experience. Survey responses were used as supplementary descriptive evidence to test whether qualitative patterns appeared more broadly in community perceptions. Where these sources converged, the finding was treated as more strongly supported. Where they diverged, the inconsistency was interpreted analytically as evidence of possible implementation gaps, communication breakdowns, institutional asymmetries or differences between formal compliance claims and lived experience. On this basis, the five cross-cutting implementation gaps identified in Section 4.5 were developed as evidence-based themes emerging from repeated patterns across the qualitative material rather than as general observations.

3.5. Limitations

The study has limitations that should be acknowledged clearly in the article.

Firstly, it is a single case study and therefore does not provide statistical generalisation across Zambia's mining sector. Its value lies in analytical insight into how safeguard implementation operates in a specific state-linked mining context.

Also, the community perception survey is descriptive rather than statistically representative. It should therefore be used to support pattern recognition and triangulation, not to claim population-wide attitudes.

Further, the study does not constitute a technical environmental audit. Community concerns about water quality, dust or land disturbance are important governance evidence, but they should not be treated as proof of environmental harm unless supported by technical monitoring data.

Lastly, access to documents may be incomplete. Where environmental approvals, monitoring reports or corrective action records are inaccessible, this should be treated as a transparency limitation rather than automatic evidence of non-compliance.

Acknowledging these limitations strengthens the article's credibility and helps keep the analysis balanced and policy relevant.

4. Findings: ESG Implementation between Formal Safeguards and Stakeholder Experience

4.1. Overview of Findings

The findings indicate that environmental and social safeguard commitments at Zambia Gold Mine are formally documented and partially operationalised. The mine operates within a regulatory framework that requires environmental assessment, management planning, monitoring and oversight. Mine personnel and regulatory actors reported that management systems and monitoring procedures exist. However, community perception suggests that implementation is uneven, identifying the most significant gaps concerning transparency, continuity of consultation, grievance awareness, regulatory capacity, disclosure and accountability.

The findings therefore do not support a simplistic compliant versus non-compliant interpretation. The mine cannot be characterized as operating in the absence of formal safeguard systems. At the same time, formal systems do not consistently translate into stakeholder-recognized performance.

This section presents findings across the environmental, social and governance dimensions.

4.2. Environmental Safeguards: Operational Monitoring with Limited Public Visibility

Environmental safeguard commitments identified in the study stemmed from the Environmental Management Act [5] and the Mines and Minerals Development Act [14] and include pollution prevention, water management, waste disposal, fuel storage controls, land rehabilitation and environmental monitoring. These commitments establish the formal environmental baseline for assessing mine-level performance.

Interviews with mine personnel indicate that environmental safeguards are integrated into operational management systems. Reported practices include quarterly water quality testing, water recycling during gold processing, pollution prevention measures, fuel storage controls and rehabilitation planning. These findings suggest that environmental management systems exist and are not merely absent from operational practice.

However, the existence of environmental monitoring does not resolve the question of safeguard effectiveness. The critical issue is whether monitoring results are independently verified, disclosed to communities, understood by stakeholders and used to guide corrective action. Where monitoring is conducted but not shared, it may satisfy internal or regulatory requirements while failing to build public trust [3].

Community respondents reported several perceived environmental impacts associated with mining operations, including land clearance and deforestation, dust and noise pollution, and soil degradation. Nearly half, 49% of respondents identified deforestation as the most significant impact of the mine's operations. At the same time, perceptions of environmental performance were mixed. About 38% of respondents acknowledged that, despite the deforestation, the mine brought economic value to the community and that some environmental management procedures were in place. Meanwhile, 19% and 21% of respondents raised concerns about dust, water quality, land disturbance, and noise pollution. These concerns should be interpreted carefully. On their own, they do not constitute conclusive evidence of environmental harm. However, they remain important because they indicate that formal environmental monitoring does not automatically translate into stakeholder confidence.

The main environmental implementation gap is therefore a transparency and communication gap. Monitoring may occur, but affected stakeholders do not have access to monitoring results in formats they can understand. This creates uncertainty and weakens the social legitimacy of environmental management. In mining governance, public confidence depends not only on whether environmental data exist, but also on whether communities can see, understand and question that data.

The implications are significant. If water quality is tested quarterly but the results are not shared with affected communities, then the safeguard system remains incomplete. If rehabilitation planning exists but progress is not communicated, communities may remain skeptical about land restoration. If pollution prevention controls are in place but corrective actions are not disclosed, stakeholders cannot verify whether the system is functioning. Environmental safeguards therefore require a public-facing component.

A stronger environmental safeguard model would include periodic disclosure of monitoring results, simplified community summaries, local-language communication, explanation of technical indicators, independent verification where feasible and clear reporting of corrective actions. Such measures would not only improve transparency but also strengthen trust and reduce the likelihood that information gaps become social conflict.

4.3. Social Safeguards: Consultation Structures with Participation and Continuity Gaps

Social safeguard commitments identified in the study from document review of

the World Bank's ESF include stakeholder consultation, community engagement, grievance mechanisms, compensation procedures where applicable and mitigation of social impacts associated with mining. These safeguards are intended to ensure that affected communities are informed, consulted and able to participate in decisions affecting their lives and livelihoods.

Mine respondents reported that community engagement activities are conducted periodically. Engagement reportedly includes meetings with local leaders, consultation forums and information-sharing sessions. The findings also indicate that community benefit arrangements are linked to traditional governance structures, including the role of the chief or royal establishment in community development allocations.

This structure has both strengths and risks. Traditional leadership may provide an important channel for local legitimacy, cultural continuity and community coordination. It may also be practically necessary in areas where customary authority plays a central role in land, community representation and local governance. Only 34% of survey respondents reported having participated in a consultation meeting in the past year, while almost 60% indicated that they receive information primarily through traditional leaders rather than direct engagement. However, the community respondents pointed out that reliance on traditional leadership alone may create participation limitations. It may reduce direct engagement with ordinary households, women, youth, persons with disabilities, informal workers, artisanal miners or groups with less access to leadership channels. The survey revealed that over 50% were of the view that these groups rarely participated in mine related consultations.

The study identifies a consultation-continuity gap through interview responses from community members and mine officials. Communities may be consulted during approval stages, periodic meetings or specific events, but consultation does not always function as a continuous participatory process. This distinction is important. A safeguard system requires more than occasional information sharing. It requires ongoing dialogue, feedback, response and adjustment.

Community respondents in interviews reported varying levels of awareness of the mine's environmental and social commitments. 34% in the focused group discussion indicated that they were unaware of any existence of a feedback mechanism, while 66% stated that it was possible a mechanism existed but they had very limited information on how to access it and how to receive feedback. Meanwhile, from the survey almost 60% expressed concerns regarding weak grievance awareness and uncertainty about how concerns are addressed and if actions were taken. These findings suggest that stakeholder engagement exists but is not consistently experienced as inclusive, continuous or responsive.

The grievance mechanism is particularly important. A grievance mechanism should allow communities to raise concerns, receive responses and seek remedy. However, its effectiveness depends on awareness, accessibility, trust and responsiveness. If community members do not know how to use the mechanism, if they

fear consequences, if they believe concerns will not be addressed, or if outcomes are not communicated, then the mechanism will not function effectively even if it exists formally [3] [10].

Through interviews with the community and mine officials, the study identified weak grievance awareness and inconsistent feedback mechanisms as part of the social implementation gap. It also notes that community engagement structures are mediated through traditional leadership, which may limit broader participation and direct community influence. These patterns reinforce the need for more inclusive and continuous stakeholder engagement systems grounded in recognized safeguard standards and participatory governance principles [3] [11].

The social findings therefore show that the problem is not necessarily the absence of engagement structures. Rather, the problem is the quality and inclusiveness of engagement. Safeguard implementation remains vulnerable where engagement is episodic, leadership-mediated, insufficiently documented or weakly connected to grievance resolution and corrective action.

A more robust social safeguard approach would include direct engagement with multiple community groups, clear documentation of issues raised, public reporting of responses, accessible grievance channels, protection against retaliation, gender-sensitive consultation, youth inclusion and regular feedback sessions. Traditional leadership should remain part of the system, but should be complemented by broader participation mechanisms.

4.4. Governance Safeguards: Formal Oversight Constrained by Capacity and Accountability Challenges

The governance dimension is central to the article's contribution. Governance determines whether environmental and social safeguards are implemented, monitored, disclosed and enforced. In the Zambia Gold Mine case, documentary evidence shows that formal governance systems exist and regulatory oversight is present. Mine respondents and regulatory actors reported inspections and monitoring. The mine's closure in 2021 and reopening in 2024 also indicates that enforcement mechanisms can produce operational consequences.

However, the governance system, according to interviews with the regulatory body, has indicated that monitoring occurs once annually and this is dependent on availability of funds. In addition, documentary analysis of Estimates of Revenue and Expenditure (Output Based Budget) 2024 to 2026 [17] has identified limited budgetary allocations to the agency to achieve its functions including general key output indicators not specific to mine monitoring. As a result, regulatory capacity constraints affect the frequency, depth and independence of monitoring. Therefore, environmental regulators require adequate staffing, technical resources, field budgets and laboratory capacity to verify mine-reported data. Where regulators lack resources, oversight may become dependent on operator-provided information. This weakens independent verification and public confidence. Occupational health and safety obligations and management-system requirements fur-

ther reinforce the need for adequate monitoring and risk control capacity in mining oversight [15] [16].

Only 28% of the surveyed respondents reported having access to publicly available environmental monitoring reports or corrective action summaries, while 72% expressed that they had never seen or accessed this information. Further, they stated that different institutions appeared to handle environmental, mining and local governance issues, and the community was uncertain of who or what reporting channels were available in which they could direct their concerns. Documentary analysis shows that disclosure systems remain underdeveloped. Environmental monitoring results, approval conditions, corrective action records and ESG performance indicators are not consistently made available to affected stakeholders. Without disclosure, communities cannot verify whether safeguards are functioning. Civil society and researchers also face difficulty assessing performance. Disclosure is therefore not an optional communication activity; it is part of accountability [1] [6].

In addition, documentary evidence shows that institutional coordination may be fragmented. Mining governance involves environmental regulators, mining authorities, labour and safety institutions, local government, traditional authorities and other public bodies. If these institutions do not coordinate information and enforcement actions, accountability gaps emerge. Communities may not know which institution is responsible for a concern, while regulators may address issues in separate institutional silos.

Lastly, state-linked ownership creates a distinctive governance issue. The state may have an interest in the mine's success as an owner or shareholder while also being responsible for regulation and enforcement. This does not prove regulatory failure. However, it creates a structural tension that should be managed through enhanced transparency, independent oversight and clear institutional separation [6] [12].

The thesis identifies this governance dynamic as one of the study's most important contributions. Documentary evidence notes that state ownership creates opportunities for stronger public accountability and developmental alignment, while also generating tensions between developmental objectives, production pressures and independent regulatory oversight.

The governance findings from literature review therefore show that ESG implementation is not only a company-level management issue, but also a regulatory and institutional issue. Mine-level ESG performance depends on the credibility of public oversight, the accessibility of information, the independence of monitoring and the clarity of accountability channels.

4.5. Cross-Cutting Implementation Gaps

Across the coded and triangulated evidence, five cross-cutting implementation gaps emerged consistently across the environmental, social and governance dimensions.

4.5.1. Information Gap

The information gap refers to the limited availability of safeguard documents, monitoring results and corrective action information in accessible formats. Only 28% of respondents indicated they had access to information. This could also be attributed to the role which they play in society. This gap affects communities, civil society and researchers. Where information is unavailable or overly technical, stakeholders cannot verify performance. Information asymmetry then becomes a source of mistrust.

4.5.2. Capacity Gap

The capacity gap concerns the resources available to regulators and mine-level systems. Only 34% indicated they were consulted in public meetings. Regulatory agencies may have formal authority but attribute this lack of consultations to having insufficient staffing, technical resources or inspection budgets. Mine-level teams may have procedures but limited capacity to institutionalise ESG across operations especially hold these meetings as frequently as is suggested through literature review of the study. Capacity limitations weaken implementation and thus, verification.

4.5.3. Participation Gap

The participation gap refers to the difference between formal consultation and meaningful participation. Engagement may occur, but not necessarily in a way that includes all affected groups or enables influence over decisions. With only 34% from the survey indicating that marginalized groups participate sometimes and not consistently. This is stressed in the responses from the survey respondents of which almost 60% stated that traditional leadership is often the channel in which consultations are made. Reliance on traditional leadership alone may not capture the diversity of community experience.

4.5.4. Grievance Gap

The grievance gap concerns limited awareness, accessibility, trust and responsiveness of grievance mechanisms. A grievance system must be more than a complaint box or formal procedure. However, only 3% were sure that grievances were received and resolved, while 59% stated that grievances were received with no action taken. It is worth stressing the importance of grievance as expressed by the literature this study presents, that it must be known, used, documented and connected to remedy.

4.5.5. Accountability Gap

The accountability gap refers to the weak connection between monitoring, disclosure, corrective action and consequences. Where monitoring results are not disclosed, grievances are not publicly tracked, corrective actions are not reported and regulatory follow-up is unclear, safeguards lose practical accountability value. Only 3% of the respondents stated that there was transparency and accountability of the mine and government agencies while over 50% of the respondents did not

think efforts to be transparent and accountable existed.

These gaps are interconnected. Information gaps weaken participation. Participation gaps reduce grievance effectiveness. Regulatory capacity gaps weaken accountability. State-linked ownership may intensify the need for transparency because stakeholders may question the independence of oversight.

5. Discussion: Why ESG Implementation Gaps Persist

5.1. Moving beyond the Compliant/Non-Compliant Binary

A central contribution of this article is that it avoids a simplistic compliant versus non-compliant binary. The evidence does not support the conclusion that Zambia Gold Mine operates in the absence of formal safeguard systems, quite the contrary. Environmental monitoring, consultation mechanisms and regulatory oversight appear to exist. At the same time, the evidence also does not support the conclusion that documentary compliance is sufficient to demonstrate effective ESG performance.

The more accurate conclusion is that ESG implementation is formally documented and partially operationalized, but unevenly experienced by stakeholders. The weakness lies in the chain linking formal commitments to substantive outcomes. This interpretation is directly consistent with the thesis conclusion that the mine should not be understood through a simplistic compliant versus non-compliant binary, because formal structures and operational efforts exist, but the chain linking safeguards to stakeholder outcomes remains weak.

This distinction matters for mining policy. Regulatory systems often focus heavily on approval, permitting and formal compliance. These are necessary, but they do not ensure that affected communities experience safeguards as protective. A performance-oriented approach requires regulators and companies to ask whether safeguards are implemented, whether monitoring data are accessible, whether grievances are resolved and whether communities trust the process.

The case therefore shows that ESG should be treated as an accountability system rather than a reporting label. ESG is credible only when commitments are connected to implementation systems, measurable indicators, disclosure, stakeholder participation, independent verification and corrective action.

5.2. Institutional Decoupling and Compliance-Driven ESG

The institutional theory helps explain why formal systems may coexist with implementation gaps. Mining companies face pressure to demonstrate compliance with legal requirements, approval conditions and professional standards. This pressure encourages the production of documents, policies, monitoring records and engagement reports. These documents may be necessary and useful, but they can also create a risk of compliance formalism.

Compliance formalism occurs when the system focuses on whether documents and procedures exist rather than whether they produce substantive outcomes. In the Zambia Gold Mine case, environmental monitoring and consultation proce-

dures appear to exist. However, community uncertainty about environmental information and grievance mechanisms suggests that formal systems are not fully coupled to stakeholder-recognised performance.

This does not mean that formal systems are symbolic only. Rather, it means that they are incomplete unless linked to implementation and accountability. Institutional pressures should therefore shift from documentation alone to performance evidence. Regulators should ask not only whether a monitoring plan exists, but whether results are disclosed. They should ask not only whether consultation occurred, but whether issues raised were addressed. They should ask not only whether a grievance procedure exists, but whether communities know how to use it and whether grievances lead to remedy.

5.3. Stakeholder Asymmetry and the Limits of Procedural Consultation

Stakeholder theory explains why participation gaps persist. Mining companies and regulators often control technical information, while communities experience impacts directly but may lack access to data, expertise or decision-making channels. This creates information asymmetry. Communities may observe dust, water changes, land disturbance or social disruption, but may not have access to monitoring results that confirm, refute or explain these concerns.

Procedural consultation does not necessarily resolve this asymmetry. Meetings may be held, but if they are infrequent, dominated by leaders, poorly documented or not linked to decision-making, they may not produce meaningful participation. Similarly, information may be shared, but if it is too technical or not available in local languages, it may not support informed engagement.

The role of traditional leadership requires balanced interpretation. Traditional authorities may provide legitimacy and an established governance channel. They should not be bypassed or treated as inherently problematic. However, social safeguards require inclusive participation. Traditional leadership should therefore be complemented by direct engagement with affected households, women, youth, vulnerable groups and other stakeholders.

A strong safeguard system should create multiple participation channels. These may include traditional leadership meetings, community forums, targeted consultations with women and youth, grievance clinics, disclosure meetings, household-level outreach and participatory monitoring. This reduces the risk that engagement is perceived as elite-mediated or episodic.

5.4. Political Economy of State-Linked Mining

The political economy of state-linked mining is one of the article's most important contributions. Public participation in mining can support national development objectives. It can also help ensure that mineral wealth contributes to public policy goals. In Zambia, gold-sector development is linked to mineral diversification and state participation, making the case significant beyond the individual mine.

However, state-linked mining also requires robust governance safeguards. Where the state is both owner and regulator, stakeholders may question whether regulatory oversight is fully independent. This concern may arise even where regulators act professionally. Perception matters because ESG accountability depends on trust. If communities believe that regulators are too close to the operator, disclosure and independent verification become even more important [6] [12].

The solution is not necessarily to avoid state participation. Rather, state-linked mining should be accompanied by enhanced transparency and institutional safeguards. These may include public disclosure of monitoring data, independent environmental audits, clear separation between ownership and regulatory functions, parliamentary or public reporting, community oversight mechanisms and transparent corrective action tracking.

This analysis contributes to policy debates by showing that ESG implementation is shaped not only by company behaviour but also by ownership structure, regulatory capacity and state development priorities.

5.5. ESG as Performance Governance

The findings suggest that ESG should be reframed as performance governance. This means that ESG is not merely about having policies, reports or community projects. It is about whether the mine can demonstrate performance against environmental, social and governance indicators, supported by disclosure, verification and corrective action [1] [6].

A performance governance approach would require clear indicators. Environmental indicators might include water quality results, dust levels, waste management performance, rehabilitation progress, spill incidents and corrective action completion. Social indicators might include consultation frequency, attendance diversity, grievance numbers, grievance closure times, satisfaction with grievance outcomes, livelihood restoration measures and community development transparency. Governance indicators might include disclosure frequency, inspection outcomes, audit findings, corrective action status and evidence of regulatory follow-up.

Such indicators would allow the mine, regulators and communities to move beyond general claims. They would also support adaptive management. If water monitoring results show concern, corrective action can be tracked. If grievance awareness is low, outreach can be strengthened. If women are underrepresented in consultation, engagement methods can be adjusted.

6. Conclusion and Recommendations

This article has examined the implementation of environmental and social safeguards at Zambia Gold Mine, specifically Kansenseli Gold Mine, as a case study of ESG operationalization in Zambia's mining sector. The analysis shows that formal safeguard systems exist and that environmental monitoring, consultation processes and regulatory oversight are partially operationalized. However, the ef-

fectiveness of these systems is constrained by transparency gaps, participation limitations, grievance awareness weaknesses, regulatory capacity constraints and governance tensions associated with state-linked ownership.

This paper's main contribution is the distinction between documentary compliance and substantive safeguard performance. Documentary compliance is necessary because it establishes formal obligations and creates an evidence base for accountability. However, it is insufficient where safeguards are not communicated, independently verified, publicly disclosed, connected to grievance mechanisms or translated into corrective action. Substantive performance requires a functioning implementation chain linking commitments, operational systems, monitoring, disclosure, stakeholder experience and remedy.

The case demonstrates that ESG implementation gaps do not necessarily arise from the absence of formal safeguards. They may arise from weaknesses in the way safeguards are implemented, disclosed, verified and experienced. This finding is important for Zambia and for mining governance more broadly. It suggests that improving ESG performance requires more than additional documentation. It requires performance-based governance.

For Zambia's mining sector, the policy implications are clear. Mine operators should institutionalize ESG systems, disclose monitoring results and strengthen grievance mechanisms. Regulators should improve monitoring capacity, require public disclosure and link approval conditions to post-approval performance. Government policy actors should clarify governance arrangements for state-linked mining and strengthen public access to environmental information. Communities should be supported to participate effectively and to use grievance and accountability mechanisms.

The case also has broader relevance for African mining governance. It shows that state-linked mining operations require particular attention to transparency and regulatory independence. State participation in mining may support development objectives, but it also increases the need for credible oversight and public accountability. ESG in such contexts should therefore be understood not as a reputational framework, but as a governance system that must be embedded in institutions, evidence, participation and corrective action.

To move beyond approval-based compliance toward performance-based safeguard governance. The mine actors should do the following:

6.1. Recommendations for Zambia Gold Company

1) Because the findings show that environmental monitoring may occur without consistent community access to results, Zambia Gold Company should institute routine public disclosure of key safeguard indicators. At minimum, the company should disclose plain-language summaries of water quality monitoring, dust management, waste handling, rehabilitation progress, incidents and corrective actions. Disclosure should be periodic, locally accessible and understandable to non-technical audiences, because transparency is central to stakeholder engagement

under recognized safeguard frameworks rather than an optional add-on [3] [6] [10].

To make disclosure meaningful, summaries should state what was measured, where samples were taken, what the results indicate relative to applicable standards, and what action was taken where problems were identified. The company should also report whether previously identified corrective actions were completed. This would directly address the information and accountability gaps identified in the study and would make ESG performance more verifiable to affected stakeholders.

2) Given that the study identifies uneven translation of commitments into practice, the company should move from broad ESG language to a formal internal performance management system. This should include clear safeguard responsibilities, annual targets, risk registers, internal review meetings, corrective action logs and escalation procedures for unresolved issues. Treating ESG as a management system would reduce the risk of institutional decoupling, where formal commitments exist but are weakly connected to operational decision-making [7] [8].

Operational indicators should be developed across the environmental, social and governance dimensions. Examples include timeliness of monitoring disclosure, number and closure rate of grievances, diversity of consultation participation, rehabilitation progress, inspection findings and completion of corrective actions. This would align the company's ESG practice with performance governance rather than documentary compliance alone.

3) The findings suggest that social legitimacy can be weakened when communities see development contributions but remain uncertain about how mine-related risks are being addressed. Zambia Gold Company should therefore distinguish clearly between community investment activities and social safeguard obligations. Community projects may support local development, but they should not be presented as evidence that mine-related impacts on livelihoods, land access, health, safety or grievance handling have been adequately managed.

A clearer distinction would improve accountability because it would allow stakeholders to assess whether the company is both contributing to local development and managing project-related risks in a structured way. This is particularly important in mining contexts where social conflict often emerges from unresolved impacts rather than from the mere absence of community investment [1] [2].

4) Because the study identifies weak grievance awareness and inconsistent feedback, the grievance mechanism should be redesigned as an active accountability tool rather than a passive procedure. The company should publicise grievance channels through meetings, noticeboards, local-language materials and direct outreach, and it should provide confidentiality options, clear timeframes, non-retaliation commitments and escalation pathways. These features are consistent with good practice in safeguard systems that emphasize accessibility, responsiveness and remedy [3].

In addition, the company should maintain an auditable grievance register and

disclose anonymized aggregate trends, including the number of grievances received, the main categories of complaints, average resolution times and the proportion resolved. Such reporting would strengthen confidence that complaints lead to action and would directly address the grievance and accountability gaps identified in the findings.

5) The study shows that leadership-mediated engagement provides legitimacy but may not by itself ensure inclusive participation. Zambia Gold Company should therefore retain traditional leadership as an important engagement channel while also creating regular forums for women, youth, directly affected households, farmers, local businesses and other groups whose concerns may not always reach leadership structures. A multi-channel participation model would improve the representativeness of consultation and reduce the participation gap identified in the study [3] [9] [11].

6.2. Recommendations for ZEMA and Regulatory Authorities

1) Because the article identifies regulatory capacity constraints as a major driver of implementation gaps, ZEMA and related authorities should strengthen independent monitoring capacity through staffing, field inspection budgets, laboratory access and technical training. Where oversight relies too heavily on operator-reported information, both verification quality and public confidence are weakened. Stronger independent sampling and follow-up inspection would make safeguard enforcement more credible [5].

In practice, this means prioritizing risk-based inspections, independent spot checks for higher-risk operations and documented verification of whether corrective actions have been completed. These steps would help shift regulation from approval-focused compliance toward post-approval performance assurance.

2) Regulators should require mines to disclose core non-confidential safeguard information in a standardized format. This should include approval conditions, monitoring summaries, inspection outcomes, status of corrective actions and information on grievance channels. Standardized disclosure would make it easier for communities, researchers and civil society to compare formal commitments with actual implementation and is consistent with the broader extractive-governance emphasis on transparency and public debate [6] [10].

3) Environmental assessment should be treated as the beginning rather than the end of safeguard oversight. Regulators should translate approval conditions into measurable post-approval obligations, such as required reporting intervals, community disclosure sessions, follow-up verification and evidence of corrective-action closure. For higher-risk projects, regulators should consider periodic independent audits or third-party verification mechanisms. This would reduce the gap between documentary compliance and substantive performance identified in the article.

4) The study shows that fragmented accountability weakens safeguard performance. Environmental, mining, labour, safety and local governance institutions

should therefore coordinate inspections, share findings and align follow-up actions. A more integrated oversight model would reduce the risk that environmental, social and governance problems are handled in institutional silos and would make accountability channels clearer to affected communities.

6.3. Recommendations for Government Policy Actors

1) Because the case involves state-linked ownership, government policy actors should clarify the separation between ownership, promotion and regulation. This does not mean that state participation in mining is inherently problematic. Rather, it means that governance arrangements should make regulatory independence visible and credible through clear mandates, transparent reporting lines and publicly understandable oversight procedures [6] [12].

Relevant measures could include independent environmental audits, public reporting on compliance status, conflict-of-interest safeguards and clearer disclosure of regulatory actions affecting state-linked operations. These mechanisms would help reduce the perception and reality of overlapping roles.

2) Government policy actors should establish minimum ESG disclosure expectations for mining companies so that disclosure is not left entirely to operator discretion. Core items should include monitoring summaries, rehabilitation progress, stakeholder engagement records, grievance statistics, major incidents and status of corrective actions. Such a framework would help move ESG from voluntary narrative reporting toward a more performance-based governance model [1] [6].

A minimum disclosure framework would also reduce information asymmetry between operators, regulators and communities, which the case study identifies as a key contributor to mistrust and weak accountability.

3) Public access to environmental information should be improved through practical disclosure channels rather than formal entitlement alone. This may include online publication of key documents, simplified summaries at district level, community noticeboards and accessible explanations of technical indicators. The objective should be to ensure that affected stakeholders can actually use the information made available, not merely that it exists somewhere in the regulatory system.

4) The article indicates that legal frameworks alone are insufficient where regulatory agencies do not have the resources to enforce them. Government should therefore provide sustained financial and technical support for post-approval monitoring, inspections, laboratory services and data management systems. Without this investment, safeguard governance will remain stronger on paper than in practice.

6.4. Recommendations for Community and Stakeholder Systems

1) Because safeguard systems are only effective when stakeholders can use them, communities should be supported to understand environmental and social

commitments, grievance pathways, disclosure rights and the institutional roles of regulators. This support should be practical rather than abstract and should explain what information can be requested, how concerns can be raised and what response pathways are available [3].

This is important because the findings suggest that weak awareness contributes directly to low use of grievance and accountability mechanisms, thereby reinforcing the implementation gap.

2) Community representation should retain traditional leadership while also ensuring direct participation by women, youth, affected households and other groups whose experiences may differ from those of recognized leaders. Inclusive representation matters because mining impacts are unevenly distributed and because exclusion from consultation can deepen perceptions of unfairness and conflict [9] [11].

3) Consultation processes should create documented feedback loops in which concerns raised by communities are recorded, assigned, followed up and reported back on. Without such feedback loops, participation can remain procedural and trust can deteriorate. A documented response system would help communities see whether engagement is influencing decisions and corrective action.

Acknowledgements

We would like to thank Zambia Gold Mine and community stakeholders for participating in the interviews, African Development Bank and UNZA, School of Mines for the scholarship.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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