School of Mining Engineering

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LARGE-SCALE MINING AND ARTISANAL AND SMALL-SCALE MINING PARTNERSHIPS FOR SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT IN ZIMBABWE

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DECLARATION

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“The standard you walk past is the standard you accept.”

Lieutenant General David Lindsay Morrison AO

ABSTRACT

The study focuses on the partnership between Large-Scale Mining (LSM) and Artisanal and Small-Scale Mining (ASM) as a pathway to address the challenges of informal ASM in mineral-rich communities. It highlights the collaboration between Pickstone-Peerless Mine (PPGM) and ASM operators under the Bluestreak Mining Cooperative (BMC) in the Chegutu district of Zimbabwe, with the goal of formalizing ASM activities to benefit local communities and the broader economy. The research seeks to provide empirical evidence and a practical model for such partnerships, which are lacking in documentation, particularly in the context of Zimbabwe. The partnership model is proposed to increase the socio-economic impact of ASM and allow the government to efficiently harness economic gains from mineral resources. Using qualitative and quantitative methods, the study assesses stakeholder perspectives and the partnership's socio-economic significance, advocating for LSM-ASM partnerships to formalize ASM operations and citing benefits like improved control, coexistence, and mutual advantages. While the PPGM-BMC collaboration has made progress in formalizing ASM and enhancing environmental and social responsibilities, further enhancements are needed for sustained community impact. Recommendations include alternative extraction methods, rehabilitation plans, and long-term sustainability plans, with future research directions exploring economic models for low-free-gold ores and LSM-ASM partnerships' role in transitioning away from mercury use, ultimately promoting sustainable mining practices and improving ASM community livelihoods.

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation	Description
%	per cent
AISC	All In Sustaining Cost
ASM	Artisanal and Small-Scale Mining
BMC	Bluestreak Mining Cooperative
CASM	Communities and Small-Scale Mining
CIL	Carbon-In-Leach
COMZ	Chamber of Mines of Zimbabwe
CRDC	Chegutu Rural District Council
CSR	Corporate Social Responsibility
EMA	Environmental Management Agency
g/t	grams per tonne
GOZ	Government of Zimbabwe
HCF	Harmonious Coexistence Framework
h	hour
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
kg	kilograms
kV	kilo Volts
kVA	kilo Volt-Amperes
kW	kilo Watts
kW/h	kilo Watts per hour
LSM	Large-Scale Mining
m	meter

m^3/h	cubic meters per hour
MACDESA	Minera Aurífera Cuatro de Enero Sociedad Anónima
mm	millimeter
MOMMD	Ministry of Mines and Mining Development
MW	Mega Watts
OHS	Occupational Health and Safety
oz	ounces
PMC	Pickstone Milling Centre
PPE	Personal Protective Equipment
PPGM	Pickstone-Peerless Gold Mine
RBZ	Reserve Bank of Zimbabwe
SMI	Small Mining International
t	tonnes
TLB	Tractor-Loader-Backhoe
UN	United Nations
UNEP	United Nations Environment Programme
VFEX	Victoria Falls Stock Exchange
ZELA	Zimbabwe Environmental Law Association
ZEPARU	Zimbabwe Economic Policy Analysis and Research Unit

1 INTRODUCTION

1.1 Research Background and Context

Large-Scale Mining (LSM) and Artisanal and Small-Scale Mining (ASM) players often clash over the exploitation of high-value minerals such as gold and diamonds. The tension may degenerate into violence and vandalism which can threaten the LSM entity's social license and the livelihood of the ASM communities. It can be argued that building sustainable LSM-ASM relationships helps the LSM entity gain the needed social license to operate in these communities (Rodriguez, 2022). It can be further argued that progressive LSM-ASM relationships create effective channels for sustainable socio-economic development in the communities involved.

LSM-ASM partnerships have been identified as one of the key avenues to address a myriad of challenges and complexities of informal ASM in communities endowed with high-value mineral resources (Commdev, 2010). Such collaborative approaches can be utilised to streamline ASM activities and formalise the sector for the common good of the communities and the rest of the economy. This study examines the model of engagement applied by Pickstone-Peerless Gold Mine (PPGM), an LSM entity in the Chegutu district of Zimbabwe, to collaborate with ASM operations in its mining concession.

PPGM entered a partnership/ tribute agreement[1], registered with the government under the Government of Zimbabwe (GOZ)'s Mines and Minerals Act of 1961 (GOZ, 1961), with a consortium of local artisanal miners. PPGM ceded four of its mining claims to the Bluestreak Mining Cooperative (BMC), allowing ASM activities to be carried out within its mining claims. This was done to mitigate conflicts with the miners and provide a sustainable means of survival to the local community.

The "partnerships" approach is considered one of the proven pathways to the formalisation of ASM, leading to the sustainable exploitation of mineral resources. Guidelines to this approach have been developed by a consortium of international organisations, namely the Communities and Small-Scale Mining (CASM), the International Council on Mining and Metals (ICMM), and the International Finance Corporation (IFC). The guidelines seek to promote action towards mutually beneficial engagements between LSM and ASM players (World Bank, 2009). The United Nations Environment Programme (UNEP, 2012) demonstrated, through different case studies, that partnerships models may differ depending on the context of engagement between players. It is therefore the intention of this study to provide a detailed account of the LSM-ASM partnership model between PPGM and BMC, to provide practical alternatives to the formalisation of ASM especially where coexistence is possible.

[1] Section 283 of the Mines and Minerals Act (Chapter 21:05) defines a tribute agreement as any agreement or arrangement where a person gives a tribute, licence, concession, authority or other right to mine a mining location to a tributor (the person who has been granted the right to mine a mining location under a tribute agreement).

1.2 Problem Statement

Despite the growing recognition of LSM-ASM partnerships as a crucial approach to formalizing ASM, there is a significant lack of empirical evidence and guidance on how to effectively implement and sustain such partnerships in Zimbabwe. The existing literature falls short in providing proper documentation of practical experiences from industry players who have successfully navigated these partnerships. Notably, there is a scarcity of documented case studies in Zimbabwe that showcase successful LSM-ASM partnerships, particularly in addressing common challenges such as:

- Clashes and conflicts within the sector;
- Illegal mining activities;
- Effective environmental management and
- Limited access to technical expertise, financing, ore processing, and market opportunities (World Bank, 2020).

This knowledge gap hinders the development of effective strategies for LSM-ASM partnerships, underscoring the need for comprehensive documentation and analysis of successful partnership models to inform policy and practice in Zimbabwe's mining sector.

While ASM plays a significant role in the livelihoods of communities and overall gold production in Zimbabwe, the sector is plagued by high levels of gold leakages and parallel markets, largely due to the informal nature of small-scale mining operations miners (Netisanda, 2020; Hunter *et al*., 2021). This results in lost revenue for the government and undermines the formalization of the mining sector. Determining effective strategies for LSM-ASM partnerships is crucial to address key challenges in Zimbabwe's gold mining sector, including reducing gold

leakages, promoting formalization, and enhancing transparency, ultimately to optimize revenue generation and ensure sustainable livelihoods for local communities.

1.3 Research Aim and Objectives

This research aims to provide a framework for the mining industry to leverage the opportunities, address the challenges of ASM and promote sustainable socio-economic development beyond mining communities.

Using the PPGM-BMC partnership as a case study, this research seeks to:

- To identify the primary goals and approaches of the LSM-ASM partnership.
- To assess the alignment of the collaboration with the individual goals and needs of LSM and ASM parties. Identify the business case for engagement on both sides of the partnership, that is, motivation for the LSM entity to engage with the ASM operations and vice versa and
- To evaluate the impact of the partnership on reducing "illegal and unregulated" mining activities in the greater Pickstone area.
- To investigate how the LSM-ASM partnership addresses critical aspects of ASM, including organization, participant selection, ownership, operational control, occupational health and safety, environmental management, marketing, and mine closure.
- To determine the outcomes of the formalized LSM-ASM relationship contributing to inclusive and socio-economic sustainability in host communities.

- To identify practical ways for LSM-ASM collaborations and investigate the potential for the "partnerships" approach to be adopted as a sustainable pathway for formalizing ASM.

1.4 Research Questions

The approach to this research was multipronged in seeking to answer the following questions:

- What were the goals of forming the LSM-ASM partnership and what approach has been applied in this collaboration?
- How well does the collaboration align with the individual goals and needs of each of the parties?
- In what ways has such a partnership impacted “illegal and unregulated” mining activities in the greater Pickstone area?
- How are the following issues dealt with through this LSM-ASM partnership:
    - The organisation of ASM activities;
    - Selection and control of participants in the cooperative;
    - In-migration of miners outside the PPGM catchment communities;
    - Ownerships and control of operations, encompassing ongoing Occupational Health and Safety (OHS), environmental management and inherent liabilities;
    - Marketing of the mineral product (raw or processed) and
    - Mine closure plans, among other issues?
- What outcomes of the formalised LSM-ASM relationship are contributing to socio-economic sustainability in the host communities?
- Can this “partnerships” approach be adopted as a sustainable pathway to formalisation of ASM?

1.5 Justification for Research

The need to streamline ASM activities stems from the significance of the sector, not only to the livelihoods of the host rural population but the rest of the economy. In 2021, the Reserve Bank of Zimbabwe (RBZ) reported that ASM producers contributed 62.5% to the country's total gold production, supported by LSM-ASM partnerships like the PPGM-BMC initiative. The remaining balance of 37.5% came from LSM producers (Reserve Bank of Zimbabwe, 2022). Reports from the Chamber of Mines of Zimbabwe (Chamber of Mines of Zimbabwe, 2017, 2018, 2020) show that gold has been contributing above 40% of the overall mineral export earnings per annum from 2015 to 2020. These statistics are supportive of the prominent role that ASM is playing towards economic development in Zimbabwe. However, with such prominence, ASM in Zimbabwe remains largely informal and unregulated which is contributing to the potential loss of revenue to the fiscus, along with various other social and environmental ills in host communities.

Notable benefits have been identified in research where LSM has integrated well with ASM. For instance, marginal deposits that are considered uneconomic to exploit by LSM companies can be economically exploited by ASM operations (Maponga, 1993), leading to the discovery of new and even bigger deposits for LSM especially in remote areas (Hentschel *et al.,* 2002). UNEP (2012) demonstrated through the Peruvian case studies that LSM-ASM collaborations can significantly contribute to the sustainable exploitation of mineral resources, responsible land use and conservation of the environment. This research seeks to address the literature gap on LSM-ASM partnerships in Zimbabwe by investigating the experiences and perspectives of industry stakeholders who have participated in such partnerships. The goal is to develop a context-specific, practical model for

the "partnerships" approach to ASM formalization in Zimbabwe, providing actionable insights for policymakers and industry players. By exploring successful LSM-ASM collaboration pathways, this case study identifies opportunities to effectively harness economic benefits from ASM. Through this "partnerships" approach, the government can capture economic rent from mineral resources across the spectrum, from marginal to highly valuable deposits, thereby optimizing revenue generation and sustainable development.

1.6 Research Limitations

Historic production data from the inception of the partnership in 2015 to 2020 was not available. Records of gold production from the Pickstone area could not be accessed from the MMMD. Other regional performance data from regulatory institutions could not be accessed. This limited the research to internally sourced data which was trusted on the basis that the same records were part of the production returns submitted to the regulatory authorities.

1.7 Structure of the Research Report

This report consists of six chapters of which Chapter 1 introduces and presents the background of the research topic, problem statement, justification for the research, research objectives and sources of data for this study. Chapter 2 reviews the existing literature, exploring the complex dynamics of ASM and its partnerships with LSM, highlighting the need for nuanced understanding and context-specific approaches to promote sustainable and equitable mineral resource management. The research methodology is presented in Chapter 3, covering the research design, data collection, validation, and analysis processes. The research tools include desktop review of existing documentation, interviews, and questionnaires,

focus group discussions and ethnography. Chapter 4 presents the background to the PPG-BMC partnership, highlighting its structure, achievements, and benefit and showcasing a successful model for LSM-ASM collaboration that promotes sustainable and equitable mining practices. Chapter 5 presents the results and detailed analysis of the research findings, addressing the various research questions posed in this study. A theoretical framework for harmonious coexistence is suggested to foster mutually beneficial LSM-ASM relationships. Finally, Chapter 6, summaries the whole research, from what the research sought to achieve to important findings and conclusions of the study. Recommendations are also presented for this study and for future research work.

2 LITERATURE REVIEW

2.1 Introduction

The ASM sector poses significant opportunities and challenges for the mining industry, with its informal nature contributing to environmental degradation, social conflicts, and economic inefficiencies. As the industry seeks to promote sustainable socio-economic development beyond mining communities, LSM-ASM partnerships have emerged as a potential solution. However, the success of these partnerships hinges on a nuanced understanding of the complex dynamics at play. This literature review aims to synthesize existing research on LSM-ASM partnerships, focusing on approaches to formalize ASM, business cases for engagement, and practical strategies for inclusive socio-economic development. By examining the experiences, perspectives, and outcomes of LSM-ASM collaborations, this review seeks to inform the development of a framework for the mining industry to leverage opportunities, address challenges, and promote sustainable development. The PPGM-BMC partnership serves as a case study, providing valuable insights into the complexities and potential of LSM-ASM partnerships in driving positive change.

2.2 ASM Formalization

Extensive research has been conducted on the unique challenges of ASM and exploring avenues to develop the ASM sector into a formalised unit (Dreschler, 2001; Zvarivadza, 2018; Teschner, 2013; Spiegel, 2009; Geenen, 2012; Hilson and Gatsinzi, 2014; Mawowa, 2013; Spiegel, 2015; Hollaway, 1997). Key themes explored in this ASM formalization literature include:

- Recognizing ASM as a legitimate economic activity through registration and licensing;
- Environmental and social impact management to ensure responsible operations;
- Health and safety measures to protect workers;
- Access to finance and markets to enhance productivity;
- Capacity building and training to equip operators with necessary skills;
- Community engagement and participation to ensure inclusive decision-making;
- Collaboration and partnerships to ensure “conflict- free” mining and the ethical production;
- Technology and innovation and
- Benefit sharing and revenue management.

Addressing these themes is essential for transforming the ASM sector into a formal, sustainable, and responsible industry that can improve lives, and contribute to sustainable development.

ASM is not a new phenomenon in Zimbabwe. Perhaps what brought ASM to the limelight in the past 20 years was its rise to prominence as a source of livelihood in mineral-endowed rural communities. This coincided with Zimbabwe's economic downturn in the 2000s, worsened by persistent droughts, which relentlessly threatened the livelihoods of the poor rural population, forcing them to turn to ASM as a means of survival (Mawowa, 2013). While societal views on ASM are varied and at times conflicting, the need to recognise the contribution of this sector cannot be ignored. Dreschler (2001) acknowledges the need to deal with the ingrained “polarisation” of ASM. Dialogue bringing out the various views by society on ASM began in the early 1990s. A United Nations (UN) led seminar on ASM in February

1990, attended by various international and local stakeholders in Harare, Zimbabwe, culminated in the development of “the Harare Guidelines” on ASM. The guidelines became the bedrock of most interventions to support, strengthen, and regularise the ASM sector in the region and beyond (Small Mining International, 1993).

2.3 LSM-ASM Coexistence

Attempts to formalise the sector are generally aligned with the key themes identified in literature. Furthermore, the World Bank (2020) has been compiling evidence on ASM's role in advancing global development, utilizing the United Nations' Sustainable Development Goals (SDGs) as a guiding framework for analysis. Formalisation attempts usually aim to deal with the negative impacts of ASM activities that include environmental degradation, poor safety and health standards, conflicts and violence and the loss of potential revenue to the government among other issues. LSM-ASM collaborations have emerged as a key solution to address these multifaceted challenges and complexities of informal ASM in mineral-rich communities (Commdev, 2010).

The United Nations Environment Programme (UNEP) highlighted three case studies from Peru, showcasing diverse partnership models between LSM and ASM actors. These cases demonstrate the importance of context-specific approaches to successful partnerships:

- La Rinconada case: An external mediator facilitated negotiations between LSM and ASM actors, resolving a long-standing conflict and establishing a successful partnership. This model showcases the effectiveness of neutral third-party mediation in building trust and finding mutually beneficial solutions.

- The San Rafael case: LSM and ASM actors formed a cooperative agreement, allowing ASM miners to operate within LSM's concession area. This partnership model demonstrates the potential for collaborative coexistence, where both parties can benefit from shared resources and expertise.
- The Santa Filomena case: LSM provided technical assistance and training to ASM miners, improving their operational efficiency and environmental practices. This partnership model highlights the value of capacity-building initiatives, enabling ASM actors to adopt better practices and improve their livelihoods (UNEP, 2012).

These case studies illustrate the diversity of partnership models between LSM and ASM actors, emphasizing the need for context-specific approaches that consider local dynamics, interests, and power relationships. By understanding these differences, stakeholders can develop more effective partnerships that promote sustainable and equitable mineral resource management.

2.4 Key Concepts, Theories and Studies

The literature on LSM and ASM collaborations highlights the potential for significant socio-economic benefits and sustainable development. However, successful partnerships require careful planning, effective legal frameworks, and a commitment to addressing the challenges and trade-offs involved. Theoretical frameworks like the Sustainable Community Development framework and the CFCR provide valuable tools for evaluating and guiding these collaborations (Rodríguez-Novoa, 2023). The World Bank identified the lack of clarity on the benefits of formalisation to the miners as one major impediment to the process (World Bank, 1992). The World Bank reported that small-scale miners view

formalisation as an advantage to the government only with little or no incentive accruing on their part. In a more recent publication, the World Bank (2020) recommended formalisation approaches that are participatory and inclusive, involving the voices and perspectives of the miners themselves (World Bank, 2020).

Proponents of formalisation have suggested various approaches that the industry may adopt while acknowledging the fact that the context of informality differs from country to country. The Harare Guidelines identified the promotion of partnerships between small, medium, and large-scale mining companies as one of the areas for action towards ASM formalisation (Small Mining International, 1993). The Zimbabwe Economic Policy Analysis and Research Unit (ZEPARU, 2019) suggested a three-pronged approach, initially proffered by Koroma *et al*. (2017). This is centred on policy and legislative reforms, partnerships among public and private entities, and incentivising the miners towards formalisation rather than penalising them. The “partnerships” approach was supported in a report by ZEPARU (2019) on pathways to formalisation. A situational report on the state of LSM-ASM relationships in Zimbabwe, published by the Zimbabwe Environmental Law Association (ZELA), also identified the PPGM-BMC partnership as an exemplary case of LSM-ASM fostered co-existence in Zimbabwe (ZELA, 2020).

2.5 Key Debates and Controversies

However, opponents of formalisation argue that ASM lends itself to abuse and exploitation by LSM as power differentials emerge in the mature stages of formalisation. Luning (2014) points out the risk of artisanal miners being dispossessed and evicted after leading the LSM to discovery of mineral deposits.

It is acknowledged that there is a risk of formalised partnerships eventually upscaling into complex relationships that are beyond the capacity of the ASM partner to manage. Formalisation by “scaling up” ASM ventures may reduce the vast opportunities created to support the livelihoods of ASM actors and their communities. To avoid this, Luning (2014) suggests other developmental objectives that counter the unequal distribution of future benefits to be provided.

Nonetheless, it is argued that a well-regulated and formalised mining operation, large or small, has more prospects for sustainability in the long term (United Nations, 2021). Its impact on human development is far-reaching beyond the local community unlike an individualistic approach to mining as depicted by informal and unregulated ASM. In essence, the variables to a successful formalisation programme are vast and complex, and the call for innovation to define a results-oriented ASM formalisation strategy cannot be overemphasised (Hilson & Gatsinzi, 2014). The benefits of establishing robust LSM-ASM partnerships far outweigh the risks of a failed engagement.

2.6 Chapter Summary

This chapter examined the complex dynamics of ASM and its relevance in Zimbabwe especially in the current times when the economic environment is dire, and droughts continue to ravage the livelihoods of the rural population. The literature review focuses on ASM formalization, business cases for engagement, and practical strategies for inclusive socio-economic development, emphasizing key themes such as recognition, environmental and social impact management, health and safety, access to finance, capacity building, community engagement, and benefit sharing. LSM-ASM partnerships were explored as an appropriate

avenue to ASM formalisation, highlighting opportunities and challenges. Successful partnerships, as showcased in Peruvian case studies, demonstrate the importance of context-specific approaches, neutral mediation, collaborative coexistence, and capacity-building initiatives. However, debates and controversies surrounding formalization highlight risks of exploitation, unequal benefit distribution, and the need for well-regulated operations. Ultimately, the chapter underscores the importance of nuanced understanding, careful planning, and context-specific approaches for successful LSM-ASM partnerships, promoting sustainable and equitable mineral resource management.

3 RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the type of research undertaken in this project and the process of how data was collected, validated, and analysed. The research methods were evaluated and justified in relation to the research problem. The quality of the research results was evaluated to confirm its adequacy in meeting the research objective.

3.2 Research Design

This research was both qualitative and quantitative in nature. The qualitative aspect included triangulation, using multiple data sources and methods to capture the perspectives and validate the responses of the various stakeholders to the partnership. Questionnaires were administered and interviews and focus group discussions were done, targeting stakeholders who include the PPGM and BMC representatives, local community leaders and relevant government and regulatory authorities. Quantitative research methods included desktop reviews of records and documents to establish the nature, structure and performance of the partnership. Data validation was done by crosschecking data from different sources to ensure consistency across different data sources. This research design enabled a comprehensive understanding of the various aspects of the research, providing a more accurate representation of the phenomenon under investigated.

3.3 Sources of Data

Data was obtained from PPGM and BMC records and this included performance reports, contracts, constitutions and by-laws, correspondence, policies, procedures, and specifications of ore processing facilities. A formal request was done and approved to use company data for this research. Supporting data on the performance of the partnership was sought from relevant government and regulatory institutions, however, no data was availed. Interviews and questionnaires were then resorted to, in order to obtain views and opinions of representatives of these institutions. The same research tools were also used to capture the opinions of other relevant stakeholders from the Chegutu community. A site visit to the ASM operations was done to appreciate the nature of activities and carry out focus discussions with the miners.

3.4 Data Collection Process

Data collection started with desktop reviews of available data, followed by interviews and questionnaires with stakeholders and, lastly, focus group discussions with the BMC miners. **Figure 3-1** summarises the data collection process and instruments used in this study.

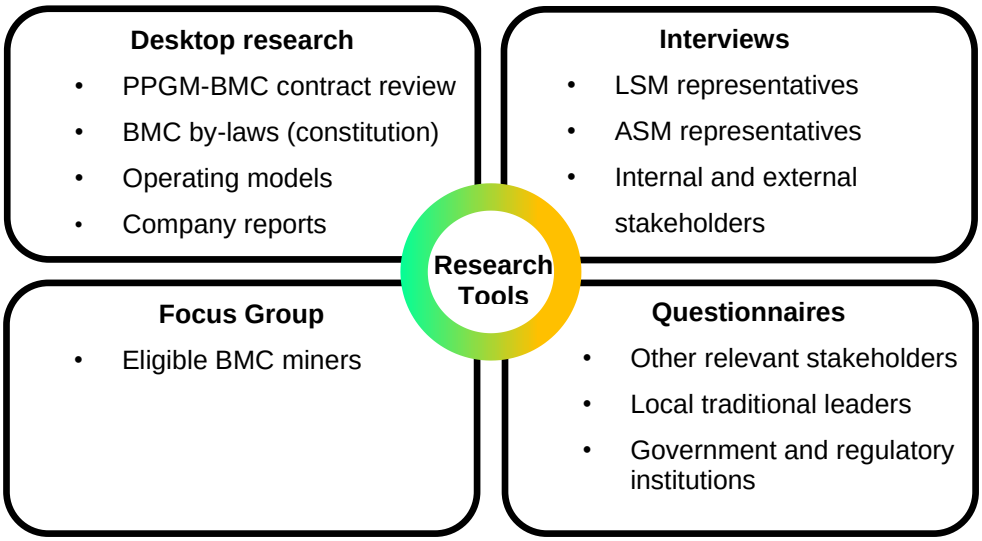

Figure 3-1 Research design and tools used in the study

The study employed quota sampling to select eligible miners engaged in ASM, working under BMC to ensure that the sample reflects the diversity of the population. Quota sampling is a non-probability sampling technique where participants are selected based on predetermined characteristics or criteria, such as age, gender or group membership. Additionally, purposive sampling was applied for the selection of PPGM and BMC representatives and the relevant stakeholders to provide rich, in-depth insights and information due to their unique position, role, and perspective with regards to the partnership. This involved selecting participants based on their expertise, knowledge, or experience in dealing with the PPGM-BMC partnership.

3.4.1 Document review

Documents and records relevant for the study were requested and received from the Pickstone Milling Centre (PMC), PPGM's small scale mining business operation. Desktop reviews were done on the following documentation:

- PPGM company reports;
- BMC by-laws (constitution);
- PPGM-BMC tribute agreement;
- PMC operational model and
- PMC gold production records.

The PPGM-BMC agreement was reviewed to understand how socio-economic sustainability is achievable under the partnership. The interpretation of the agreement by both parties was sought to:

- Clarify expectations and obligations;
- Determine key factors driving value creation and

- Assess the agreement's adequacy and effectiveness in promoting socio-economic development.

The assessment involved examining:

- Benefits accruing to the local community;
- Upward, downward, and lateral economic linkages created at the local and regional levels;
- Challenges being encountered and how they are being resolved and
- Opportunities for continuous improvement to enhance value creation and distribution.

The economic significance of the partnership to PPGM and BMC individually, the local community and the nation at large was assessed. The assessment focused on the following aspects:

- Equitable inclusion and participation of the local community;
- Control of illegal miners' in-migration, and
- Fair value delivery to the miners involved in the partnership.

The BMC by-laws were also reviewed to understand the ideology and needs of the ASM organisation. The scope of the partnership in preparing the participants for life after mining was also considered by reviewing the incorporation of mine closure plans in the agreement. Historic production data and the PMC’s business model were reviewed to appreciate the value created over the years and understand the strategic direction of the partnership. Documentation obtained and reviewed for this study originated from PPGM and BMC. No records or data related to the PPGM-BMC partnership could be accessed from government and regulatory authorities to understand the contribution of the partnership to the regional economy.

3.4.2 Interviews and questionnaires

Interviews and questionnaires were administered with representatives of PPGM and BMC as well as key stakeholders to the partnership. The aim was to capture the motivation for, performance and relevance of this LSM-ASM collaboration. The interviews were conducted from the 15th of December 2023 to the 31st of January 2024. Responses from participants on the successes, lessons learnt and opportunities for improvement in the execution of the partnership were recorded and used to evaluate the effectiveness of the partnership. External stakeholders interviewed included the local traditional leaders and representatives of the Chegutu Rural District Council (CRDC). Other stakeholders responded to the stakeholders' questionnaire, and these included the Ministry of Mines and Mining Development (MMMD), Environmental Management Agency (EMA), Zimbabwe Republic Police (ZRP) and some members of the local community.

Table 3.1 shows the statistics of interviews and questionnaire requests and responses across the categories of respondents.

Table 3.1 Interview and questionnaire requests and responses

	Requested				Responded				Response Rate
	PP	**BMC**	**Stakeholder**	**Total**	**PP**	**BMC**	**Stakeholder**	**Total**	
Interview	3	4	6	**13**	3	2	4	**9**	**82%**
Questionnaire	2	2	4	**8**	1	1	5	**7**	**70%**
Total	**5**	**6**	**10**	**21**	**4**	**3**	**5**	**16**	**76%**

A total of 16 responses was obtained from 21 requests which gives an overall response rate of 76%. **Figure 3-2** shows the distribution of responses from the various groups which participated in the research.

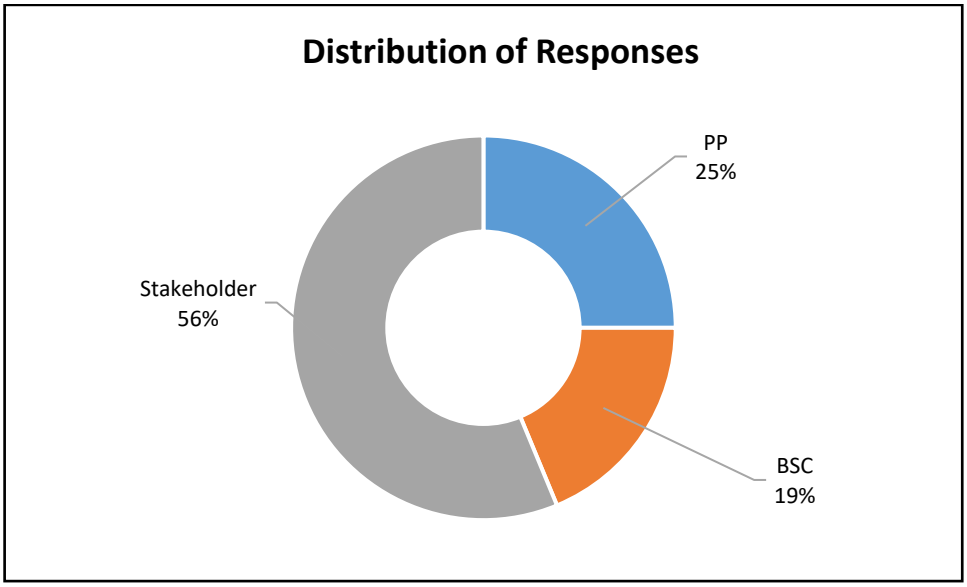

Figure 3-2 Distribution of responses from research participants

The highest percentage of respondents were stakeholders to the partnership at 56%. This was acceptable given that the applied research tools i.e. interviews and questionnaires, were targeting this group of participants to capture their views on the partnership's performance. These responses were critical in validating the data collected through desktop reviews and interviews with the PPGM and BSC representatives. Although respondents from the BMC were the smallest sample of 19% in interviews and questionnaires, the voices of the BMC's miners contributed separately to the research through the focus group discussion which was attended by 23 miners. 1 BMC committee member, and 1 PPGM management representative were not available for interviews while 3 requests, made to the representatives of the MMMD, EMA, and ZRP to complete the stakeholder's questionnaire, were not responded to. Regrettably, the targeted respondents did not communicate the reasons for their non-participation.

While a structured interview guide was developed, the actual interviews were conducted in a flexible and conversational manner to foster an open exchange of

ideas. This flexible approach enabled the collection of candid and unfiltered responses while ensuring the research remained objective and focused on the research question.

3.4.3 Field visit and focus group

A focus group discussion with the miners who are members of BMC was conducted in the field after a site visit with the leadership of the cooperative on the 22nd of February 2024. This was attended by 23 miners. During the visit, several aspects of the research were confirmed on the ground and the interaction with the miners yielded a better understanding of the peculiar nature of ASM operations in Zimbabwe.

3.5 Research Ethics

Ethical clearance for this study was granted by the School of Mining Engineering on December 13, 2023, with an expiry date of December13, 2026, under the protocol reference number EMINN/2023/101. To protect participants' confidentiality and anonymity throughout the research, the following measures were taken:

- Informed consent was obtained from all participants, ensuring they understood the purpose, risks and benefits of participation, and their rights;
- Participants were assigned pseudonyms and numbers to maintain anonymity in focus group discussions, interviews, and questionnaire responses;
- Confidentiality agreements were signed by participants, ensuring discussions and responses remained private;

- Focus group discussions and interviews took place in a secure, quiet environment, free from interruptions or observers;
- Interviews were conducted privately, with only the researcher and participant present;
- Questionnaires were completed anonymously, with no identifying information collected and
- After data collection, participants were reminded of their confidentiality agreement and the importance of maintaining anonymity.

Interview sessions lasted 1 hour on average. All the interviews and focus group discussions were audio recorded and the audio files, questionnaire answers and company documents were securely stored in a password-protected online storage account. Ethics clearance documentation was annexed in Appendix A.

3.6 Data Analysis Approach

Audio recordings from interviews and focus group discussions were transcribed to notes while questionnaire responses were consolidated in a spreadsheet to enable data analysis. Detailed transcripts of the audio recordings are presented in Appendix A. The data was then grouped into categories of the aspects being investigated and analysed to identify themes, patterns, and insights in response to the research questions posed. Key observations and findings were then drawn from the consolidated data to answer the various aspects of the research objectives.

Performance data, obtained from production reports submitted to the MMMD, was analysed to show the performance trend of the PPGM-BMC partnership in contributing to national gold production. The ASM gold value chain was analysed

to understand the distribution of value and benefits from the extractive process. This was done to qualify the existence of the partnership, account for the potential benefits accrued by both parties and show the motivation for a continued relationship between the two parties.

3.7 Data Validation Process

To ensure the validity of the results, a multi-faceted approach was employed. Reliability, generalisability and credibility of data was ensured by triangulation of research techniques. Respondents were selected from eligible stakeholders, with their eligibility being determined by verifying membership, affiliation, leadership or active participation in a particular institution or group. Interview questions and questionnaires were structured in a way that would allow validation of responses from either side of the partnership. Responses from stakeholders indirectly involved in the partnership also provided additional validation on the various aspects that were under investigation. Production statistics were cross-checked with data sourced from the PPGM's main processing plant where leaching and smelting of the PMC cyanide gold is done. The focus group discussion with the BMC miners also assisted in validating the rest of the data collected through interviews, questionnaires and desktop reviews. Consistency was ensured by checking the responses from a large sample of respondents and obtaining alternative perspectives from all parties involved, thereby guaranteeing the accuracy and reliability of the findings.

3.8 Chapter Summary

Both qualitative and quantitative research methods were applied to capture the expectations of the parties and stakeholders to the partnership and evaluate its

contribution sustainable economic outcomes. Research tools used included interviews, questionnaires, focus group discussions and desktop reviews of records and documents. Participants in this study were selected by quota and purposive sampling. Data validation was achieved by structuring the various research instruments to cross examine the responses from either side of the partnership. Responses from stakeholders to the partnership also provided additional validation on the various aspects that were under investigation. Interview audio recordings were transcribed, and questionnaire responses consolidated into a spreadsheet for data analysis. Data analysis was then performed on the data to identify key themes and findings in response to the various aspects of the research objectives. The research design was suitable for the study and extensive enough to capture the views of various stakeholders who are beneficiaries of formalised ASM activities in the Pickstone and Chegutu district.

4 BACKGROUND OF THE PPGM – BMC PARTNERSHIP

4.1 Introduction

This chapter explores the background to the PPGM-BMC partnership, showcasing how LSM-ASM collaboration model is promoting sustainable and equitable mining practices. The case study was explored in the following order:

- Motivation for the formation of the partnership;
- Operational structure established;
- Business model for the partnership;
- Nature of the PPGM-BMC tribute agreement and
- Processes and activities involved under the partnership.

Data from production reports between 2021 and 2023 was reviewed and presented.

4.2 Formation of the Partnership

The LSM-ASM partnership between PPGM and BMC came into existence in 2015. PPGM had been on care and maintenance since 1972 after the closure of the Pickstone underground mine. Only surface exploration activities were ongoing until the current shareholders acquired the asset to resuscitate LSM mining operations. Informal ASM groups were operating on the Peerless deposit at the time, including an unregistered cooperative named Kubatana which later reorganised to form BMC. ASM was the main source of income for the local Pickstone community, comprising of former mine employees, migrant ASM groups, farmers, and the natives in the rural areas around the mine. PPGM needed to commence open pit mining operations on the occupied Peerless deposit. The engagements with the

local traditional and political leaders led to the assisted removal of ASM operations from the Peerless mining area to allow LSM operations to proceed uninterrupted.

The mine invited organised ASM groups from the Pickstone and Chegutu communities to apply for mining tributes to be issued by the mine for miners to work on selected claims. Young people from the community were mobilised to form one cooperative, BMC, which was given new areas to mine under the tribute agreement. The miners were relocated to PPGM's Bluestreak mining claims where they would develop shafts and mine their ores for processing at nearby custom milling plants. PPGM granted BMC a startup loan to install an electricity supply line to the shafts, purchase mining equipment and startup consumables that included compressors, jack hammers, hoses, explosives, diesel, etc.

BMC commenced mining operations on the Bluestreak claims with a total of 86 members working on 4 mining claims registered under the tribute agreement. Priority was given to youths and women from the local community to become members of the cooperative. In 2017, PPGM constructed and commissioned a custom milling plant, the Pickstone Milling Centre (PMC), with 2 round mills dedicated for the processing of ores mined by the cooperative.

4.3 The Operational Structure

The registered mining company, Breckridge Investments, is wholly owned by Dallaglio Investments which is a subsidiary and mining business venture of the Victoria Falls Stock Exchange listed Padenga Holdings (Padenga, 2021). Breckridge has invested in both LSM and ASM operations in the Chegutu district of Mashonaland West province of Zimbabwe since 2018. This strategy was meant to address a myriad of challenges that arose with the inception of LSM in areas

where informal ASM was rampant. The company needed to engage the local community to secure the social license to operate on a large scale in areas where ASM activities pre-existed. This was achieved on one front by creating formal employment and trade opportunities through the LSM operations and, on the other front, by opening some of its claims to be worked by the local community under a structured partnership arrangement. The objective was to allow ASM to continue formally, thus, creating a sustainable form of ASM that would maintain the already existing source of livelihood for the community. **Figure 4-1** shows the shareholding and operational structure for the mining company, Breckridge Investments.

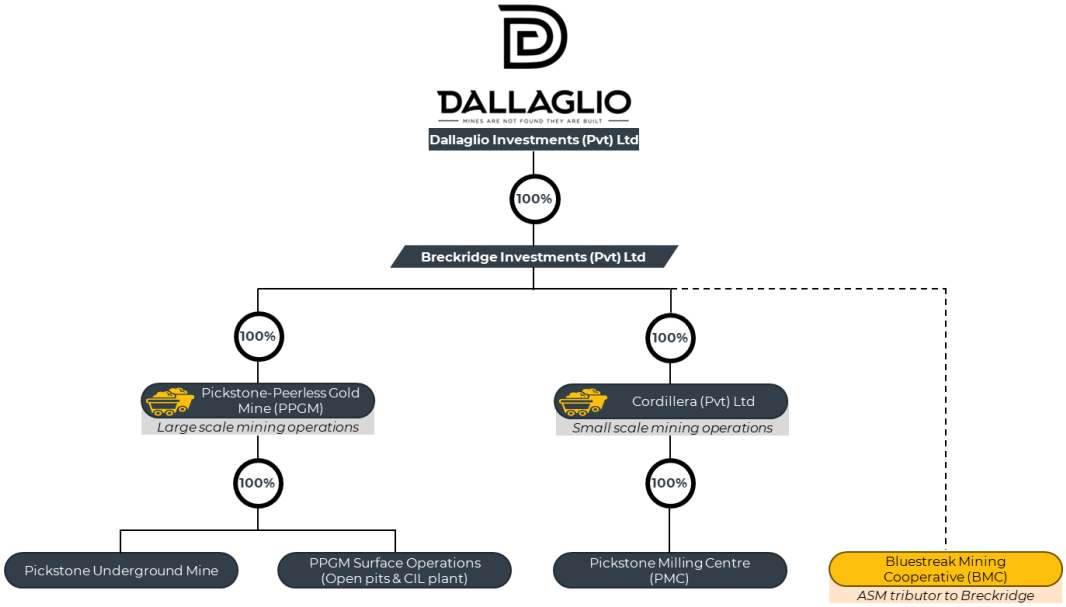

Figure 4-1 Breckridge shareholding and operational structure[2]

PPGM is Breckridge's flagship mining entity which is categorised as a LSM operation. Cordillera was formed under Breckridge as its formal small-scale mining business unit which would operate the Pickstone Milling Centre (PMC). The

[2] Adapted from an internal presentation: PPGM Operations Presentation_2024_(short version).pdf

operation is classified under the Mine Size Index (MSI) for small scale mines, defined by Dallaglio (2023) as follows:

- **Employment Level**: Small ≤ 60 (currently employs a total of 46 employees of which 7 are salaried and 39 are waged).
- **Production Level:** Small ≤ 72,000 tonnes per year (2022 Projection – 36,277 tonnes; 2023 Forecast – 45,625 tonnes).
- **Mine Load:** Small ≤ 2 MW (Current Load – average 100 kW/h).

While Breckridge has applied the MSI to categorise its ASM operations, Zimbabwe's key mining legislation, the Mine and Minerals Act, does not explicitly distinguish between LSM and ASM. However, GOZ (2019) attempts to categorise the mines into formal large scale, formal small-scale, and informal small-scale and artisanal operators.

In summary, PPGM represents Breckridge's interests in LSM and Cordillera represents Breckridge's interests in ASM. Cordillera, through the provision of ore processing and gold purchasing facilities, therefore, provides the linkage between PPGM and BMC as a typical model for LSM-ASM partnerships.

4.4 The Business Model

Cordillera's business model for the PMC is to process the ore delivered by the BMC miners. The miners recover free gold, after milling, amalgamation, and smelting, which they sell to Cordillera on site and retain the proceeds of the sale. PMC takes over the tailings for further beneficiation through PPGM's main Carbon-In-Leach (CIL) processing plant. This model can be referred to as the "free gold" model for the purposes of this study. Cordillera's 5-year vision is to produce 5,400 ounces of gold per annum from the ASM operations at an All-In Sustaining Cost

(AISC) of US$1,200/oz. AISC is a metric used to measure the total cost of producing an ounce of gold. It includes all the costs associated with mining, processing, and selling the product, as well as sustaining capital expenditures.

4.5 The Tribute Arrangement

4.5.1 Administration of the tribute

Cordillera, through the parent company, Breckridge Investments, entered into a tribute agreement with BMC to mine ore from the Breckridge claims and supply to the PMC[3]. **Figure 4-2** shows the 17 mining claims, highlighted in red, tributed to BMC under a formal three-year tribute agreement which was renewed in April 2022.

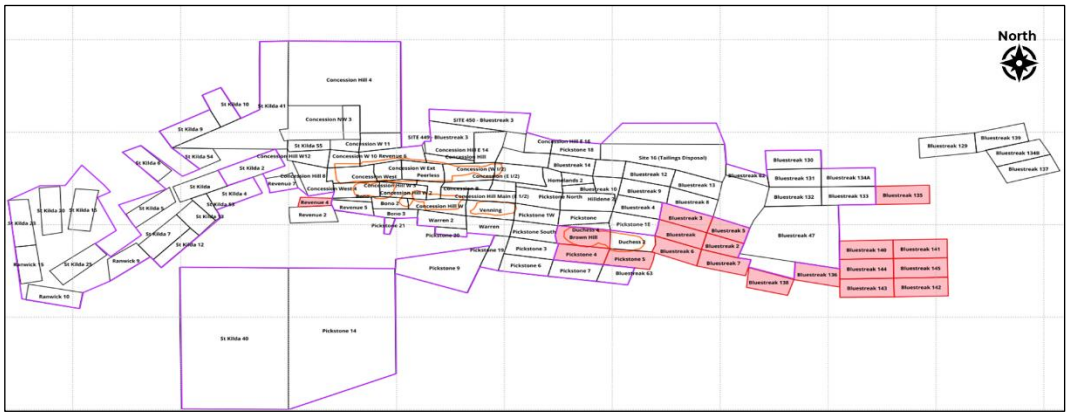

Figure 4-2 Mining claims tributed to BMC[4]

BMC is administered by a committee of 7 members comprising of a chairperson, vice chairperson, secretary, vice secretary, treasurer and 2 committee members. The cooperative employs a mine manager who has over 25 years of small-scale

[3] Obtained from an internal document: PPGM_BMC Tribute Agreement.pdf
[4] Adapted from an internal document: PPGM_Bluestreak Mining Claims.pdf

gold mining experience to manage the ASM activities. The tributor, BMC, works independently and assumes full responsibility for the safety and health of miners and environmental management within the tributed claims as required by the law (BMC, 2015a). As of December 2023, BMC miners were delivering 50% of the ore processed by PMC from 16 operational shafts across 6 mining claims (Dallaglio, 2024a).

4.5.2 Review of tribute agreement

The current tribute agreement between PPGM and BMC was reviewed to understand the distribution of responsibilities and confirm its validity. PPGM, as the grantor and registered holder of the listed mining claims, has renewed its 3-year tribute agreement with the tributor, BMC, for the third term now. The current term expires on the 1st of October 2024[5]. The agreement was registered with the MMMD as legislated.

The agreement outlines the responsibilities of the tributor in a mining operation. These include ore development and treatment, adherence to legal and safety regulations, environmental protection, and employee welfare. The tributor must also maintain infrastructure, manage waste, pay royalties, and handle administrative duties related to the claims. Additionally, the tributor is responsible for reporting discoveries and ensuring public safety, particularly concerning arsenic and mercury compounds, while assuming full responsibility for the mining claims as if they were the owner.

[5] PPGM-BMS Tribute Agreement.pdf

4.6 The Gold Value Chain

The ASM gold value chain from exploration to smelting and sale of bullion is presented in this section. Appendix B shows this value chain in pictures taken during the site visit at the BMC shafts and PMC plant.

4.6.1 Geological setup

Cordillera relies on the artisanal miners' knowledge and experience to find and deliver the ore of the required grades. No exploration drilling is informing current mining activities on the tributed claims and PPGM has no immediate plans to invest in drilling over the same area. The sitting of the shafts is done by the miners themselves by looking for signs of mineralization, such as rock formations, veins, or outcrops. The gold mineralisation is hosted in Banded Iron Formation (BIF) and quartz veins. The shafts vary in depth and orebody width, the deepest extending to 60m in depth on a 4.5m reef width while the rest of the shafts average 28m depth and 1m reef width. It has been observed that the potential to recover free gold decreases as mining depth increases beyond 35m of the orebody and this makes ASM for free gold unattractive to the miners. Cordillera has employed a geologist to support the miners in grade control and sampling to ensure both the miners and the PMC maximise value from their effort.

4.6.2 Ore supply

At the time of the site visit, 45 shafts were operational on the Duchess Hill East claims. The BMC leadership, in consultation with the Cordillera geologist, prioritises areas to be mined by their members within the tributed claims. The miners work in small groups, using compressed air powered jackhammers for drilling and other rudimentary tools such as picks, hammers, and shovels. The ore is hoisted to the surface using a windlass, rope, and bucket system. The ore is

stockpiled on surface until it accumulates to an 8t truck load before it is transported to the PMC for processing. Cordillera takes samples of the stockpiled ore and assays the grade before collecting the ore to ensure the delivered ore meets their cut-off grade for processing. Cordillera is responsible for the collection of ore from the miners, allowing Cordillera, as the grantor, to verify the ore sources before processing. Each group of miners operates independently throughout the gold value chain from mining, transportation, crushing, milling, panning of tailings, to recovery, amalgamation and smelting of the gold for sale. Security of ores at the shafts is organized by the cooperative while PMC has its own security inside the processing plant.

4.6.3 Ore processing

Cordillera has since expanded the custom milling plant from 2 to 8 round mills to reach a ‘name plate’ capacity of 48,000 tpa. The ‘name plate’ capacity refers to the maximum design capacity that the mill is designed to achieve under ideal operating conditions, as specified by the manufacturer or designer. **Figure 4-3** is a schematic diagram of the plant set up at the PMC.

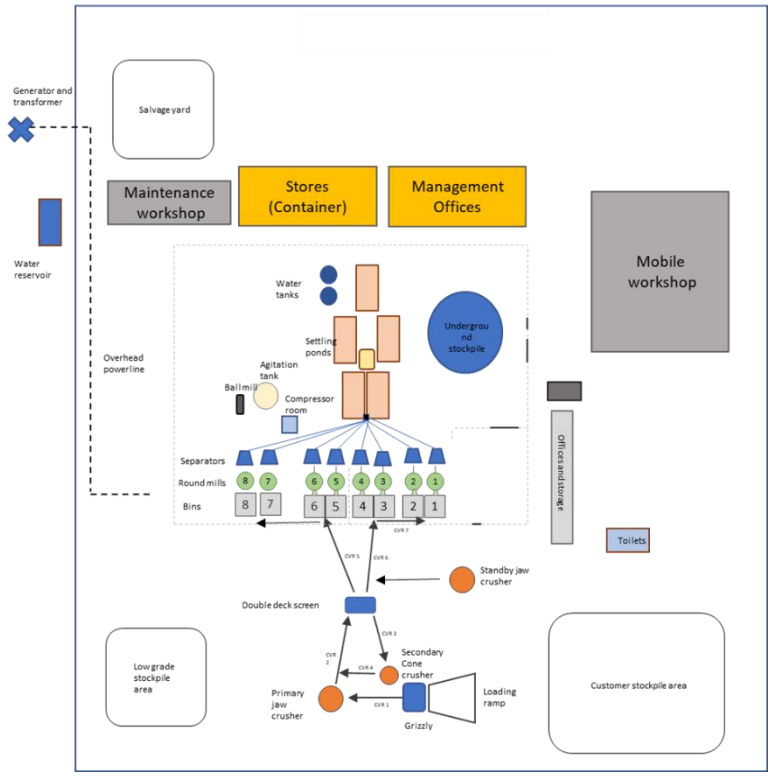

Figure 4-3 Schematic diagram of Cordillera's PMC site set up[6]

The plant comprises of a series of primary and secondary crushers, serviced by a conveyor belt system, grizzlies, and screens for material classification. The miners operate and monitor the whole beneficiation process from ore crushing to gold recovery under the direct supervision of the PMC security personnel. Miners take turns to process their ore in batches, enabling each group to extract free gold from their ore batches before handing over the plant to the next group. The broken ore from the grizzley is fed through the primary and secondary crushers to reduce particle size to 10mm of fine ore. The fine ore is fed into 15t-capacity surge bins which then supply the 8 round mills with each bin dedicated to a mill.

[6] Adapted from an internal document: Cordillera Business Operating Model FY2023.docx

After milling, the milled concentrate is discharged into coil bowls where the nugget gold is trapped with blankets and the fine gold is discharged into a separator. The rest of the tailings are panned at the panning bay to further recover free gold. The remaining tailings are fed back into the mills once the miners finish panning, and all the tailings are transferred to dedicated settling tanks for further processing through PPGM's main CIL plant. At this point, the miners continue the beneficiation process on the gold concentrate collected in the separator as well as gold recovered from panning. Mercury is added to the concentrate in the separator to form an amalgam from which the gold is recovered by burning off the mercury using a blowtorch. **Figure 4-4** shows the ore processing flow chart for the BMC miners to the point of recovering free gold.

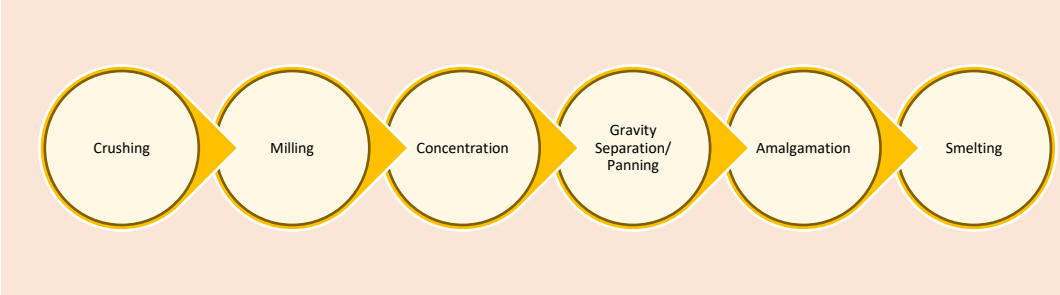

Figure 4-4 Process flow diagram for free gold recovery from ore

The tailings collected by PMC are pumped to the PPGM's main CIL processing plant where they are mixed with a leaching solution, cyanide, that dissolves the gold, allowing it to be extracted. The gold-bearing solution from the leaching process is passed through activated carbon, which adsorbs the gold. The gold is then desorbed (eluted) from the activated carbon using a hot water or chemical solution, producing a gold-rich solution. After elution, the gold-rich solution is passed through an electrowinning cell, where an electric current is used to deposit the gold onto a cathode. The activated carbon is regenerated to restore its adsorption capacity, allowing it to be reused. The gold deposited on the cathode is then removed and melted in a furnace (smelting) to produce a gold dore bar.

Figure 4-5 shows the process flow chart for the tailings, taken by PMC for further processing through PPGM's main CIL plant.

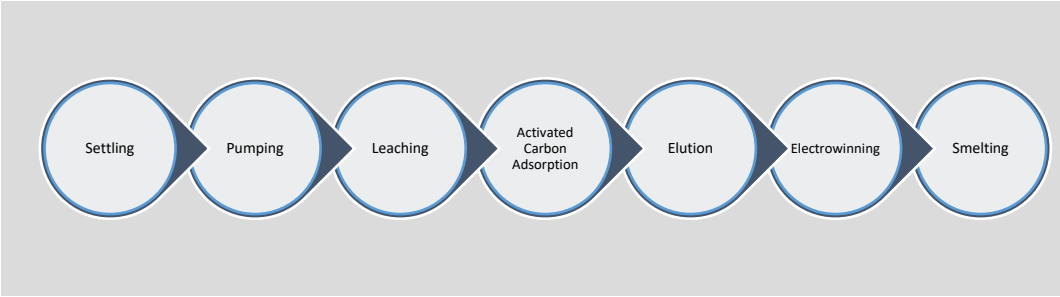

Figure 4-5 Process flow diagram for gold recovery from tailings

4.6.4 Gold marketing arrangement

The artisanal miners retain the free gold after milling, amalgamation, and smelting. The gold dore is weighed and sold to a dedicated third-party gold buyer on site, contracted to buy under Cordillera's gold buying license. The fineness of gold dore is determined by a simple water density test and a maximum of 96% fineness is applied to all customer gold sales. The smelted gold, however, averages 94% fineness.

The gold dore is purchased at the United States of America (US) dollar spot price, less the gold buyer's 9% commission. BMC retains 10% of the proceeds, of which 5% goes to its treasury to fund running costs which include equipment hire and administrative costs, while the other 5% goes to the grantor, PPGM, for royalties. The rest of the sales proceeds are surrendered to the particular ore suppliers among the artisanal miners.

4.6.5 Distribution of value among miners

Downstream profit-sharing arrangements continue among the miners depending on whether their activities are sponsored or not. In most cases, the artisanal miners are sponsored by an individual who is a member of the BMC or the cooperative

itself. All expenses incurred by the sponsor are deducted from the sales proceeds and these expenses are well recorded and documented during the time of mining production.

The shafts worked by the small groups of miners are usually ‘owned’ by certain individuals within the cooperative. The idea of owning the shaft arises from the principle that one must use their acquired exploration and mining skills to locate the reef and peg a shaft for their group to work on. The one who makes the discovery becomes the owner of the shaft, who may opt not to participate in the actual mining while collecting royalties. Therefore, once the running costs are deducted and retained by the sponsor, the shaft owner further retains 50% of the remaining sales proceeds. The balance is equally shared among the group members who mined and supplied the ore.

4.6.6 Resourcing the small-scale operations

The PMC operation is manned by a team of salaried and waged staff who operate and maintain the equipment on the Cordillera’s payroll. The key salaried roles include processing manager, production superintendent, maintenance superintendent, mining technical services officer, shared services officer, and a management accountant. Day-to-day activities in the plant are carried out by waged employees who man the crushing, milling and pumping processes and operate and maintain the equipment.

PMC deploys its mobile equipment to collect and deliver customer ore from the shafts to the plant at an agreed cost which is deducted from the sales proceeds. The existing fleet comprises of 3 tractor dumpers and 2 Tractor-Loader-Backhoes (TLB). The plant requires 140m^3/h of mine water, which is supplied, from dewatering of the Pickstone underground mine, into a 420m^3 water storage pond

at the PMC. Electrical power supply to the plant is through a 33kV power line from the national grid and a 350 kVA standby generator has been installed as backup power supply for the entire plant at full load.

4.7 Historic and Future Production

Table 4.1 shows the annual production for the past 3 years, based on production returns kept by the PMC and projected production for 2024 and 2025.

Table 4.1 Historic and planned gold production from the BMC miners

Parameter	Unit	Actual Production			Budget	
		2021	2022	2023	2024	2025
Milled tonnes	t	22,467	39,565	40,271	44,415	44,294
CIL feed grade to main plant	g/t	1.58	2.06	1.33	1.70	1.70
Gold recovery	%	82%	82%	82%	84%	84%
Gold recovered by PMC	kg	29	67	44	63	63
PMC gold sales	**oz**	**930**	**2,150**	**1,410**	**2,040**	**2,030**
Free gold recovered by BMC	kg	1.3	3.7	6.6	5.5	5.5
Total gold recovered	kg	30	71	51	69	69
Free gold proportion	%	4%	5%	13%	8%	8%

Production data from the inception of the partnership in 2015 and processing of ore at PMC from 2017 to 2020 could not be obtained. It can be observed from **Table 4.1** that the BMC miners have grown both the PMC production and their share of free gold recovered from ore supplied between 2021 and 2023. Milled tonnes, delivered by the BMC miners, increased by 79% between 2021 and 2023 and a further 10% increase is projected to 2025. Similarly, gold production increased by 52%, and a further 44% is projected for the same periods. This, in turn, has seen the share of free gold accruing to the BMC miners from the total annual gold production increasing from 4% to 13% by 2023 and is projected to stabilise at 8% of total gold produced by the partnership up to 2025. It can be

observed from the historic and planned gold production records that the individual goals for PPGM and BMCs' participation in the partnership are being met.

4.8 Chapter Summary

This chapter has shown that the PPGM-BMC partnership, formed in 2015, is a typical LSM-ASM collaboration established in Zimbabwe's Chegutu district. Breckridge Investments, the parent company, aimed to address challenges arising from LSM in areas with pre-existing informal ASM activities. The partnership formalized ASM operations, providing a sustainable source of livelihood for the local community while maintaining social stability. Key aspects of the partnership include:

- Relocation of ASM operations from occupied deposits to designated claims;
- Formalization of ASM through tribute agreements;
- Access to resources, equipment, and markets for ASM operators;
- Community development through prioritized employment and economic empowerment and
- Mutual benefits for both LSM and ASM operators.

The partnership has achieved significant growth in production, with milled tonnes increasing by 79% between 2021 and 2023, and gold production increasing by 52%. The share of free gold accruing to BMC miners has also increased from 4% to 13% during the same period. The partnership's success can be attributed to its structured approach, which includes:

- Clear roles and responsibilities for both PPGM and BMC;
- A tribute agreement outlining the terms of the partnership;
- A business model that allows for the processing and sale of gold and

- A gold value chain that ensures fair distribution of value among the miners.

Overall, the PPGM-BMC partnership serves as a model for LSM-ASM partnerships, demonstrating the potential for collaborative and sustainable mining practices that benefit both LSM companies and local ASM communities.

5 RESULTS AND ANALYSIS

5.1 Introduction

This chapter presents the results from the research study and detailed analysis of the results, leading to the determination of findings in response to the research questions and objectives of the study. Responses to the stakeholders' questionnaires and interviews are presented in this chapter and these intended to answer the structured research questions on various aspects of the partnership. The findings were analysed to evaluate the PPGM-BMC partnership's potential as a model for formalizing ASM. The evaluation focused on the objectives of the partnership, alignment with stakeholders' goals, impact on illegal mining, management of ASM activities and its contribution to socio-economic sustainability.

5.2 Research Results

5.2.1 Document review outcomes

The document reviews revealed valuable insights into the LSM-ASM partnership, showcasing its potential as a viable model for formalizing ASM. The partnership's primary objective was to mitigate the challenges posed by LSM in areas with existing informal ASM activities. To achieve this, the partnership adopted a structured approach, which involved formalizing ASM operations, providing a sustainable livelihood for the local community, and maintaining social stability. This collaborative initiative successfully aligns with the individual goals of PPGM and BMC, enabling PPGM to secure a social license to operate and BMC to access essential resources, equipment, and markets. Moreover, the partnership

addresses the needs of the local community by creating employment opportunities and promoting economic empowerment. Notably, the partnership has contributed to the formalization of ASM activities, significantly reducing the incidence of "illegal and unregulated" mining in the greater Pickstone area.

The partnership demonstrated sufficient capacity to address key operational and sustainability issues by establishing a structured approach to ASM activities, with BMC overseeing day-to-day operations. A committee within BMC manages participant selection and ensures local miners have opportunities, reducing in-migration. Clear roles and responsibilities are defined, with PPGM providing resources and BMC managing operations. The partnership has established protocols for occupational health and safety, environmental management, and liabilities, aligning with legal and regulatory frameworks for tribute agreements. A marketing arrangement is in place, with Cordillera purchasing gold from BMC and miners retaining sales proceeds. While mine closure plans are not explicitly addressed, the partnership has established a sustainable mining approach. The partnership has increased local employment and economic empowerment opportunities, improving miners' and their families' livelihoods. The document reviews suggest that this partnership approach can serve as a sustainable pathway for ASM formalization, meeting the needs of all parties involved and promoting socio-economic sustainability.

5.2.2 Questionnaire and interview outcomes

Responses from stakeholders who participated in the questionnaires and interviews were consolidated and these are presented in this section. **Figure 5-1** shows responses from the stakeholders to the LSM-ASM partnership on their expectations from the partnership.

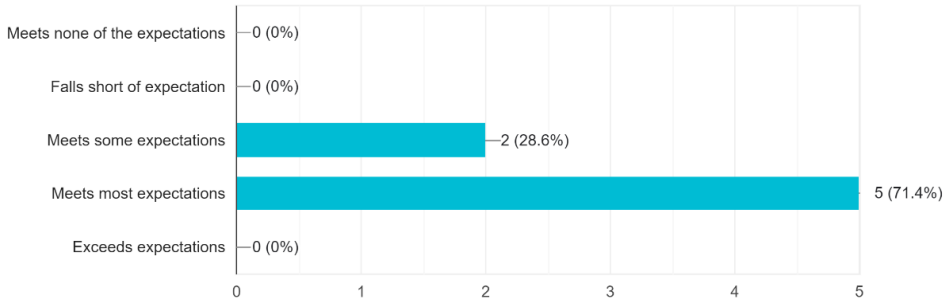

Figure 5-1 Questionnaire responses on stakeholder expectations

All the respondents acknowledged that there are positive outcomes from the partnership. 71.4% agreed that most of their expectations are being met while 28.6% were not overly impressed. Areas of improvement highlighted by interview participants in meeting the expectations of their constituencies include the following:

- The community alleges a lost sense of ownership of the mining processes and expected benefits as they feel the administration of the cooperative is being personalised by a few individuals;
- The miners working under the cooperative also expressed their concern on inadequate provision of mining equipment by the cooperative. They expect to be provided with adequate mining equipment such as compressors, jackhammers, and pumps as well as water supply to support their operations and
- PPGM representatives also highlighted lack of reinvestment by the cooperative in growing its capacity as evidenced by frequent requests by the cooperative leadership for loans to fund mining operations.

Responses from stakeholders on the impact of the partnership in streamlining ASM activities are shown in **Figure 5-2**.

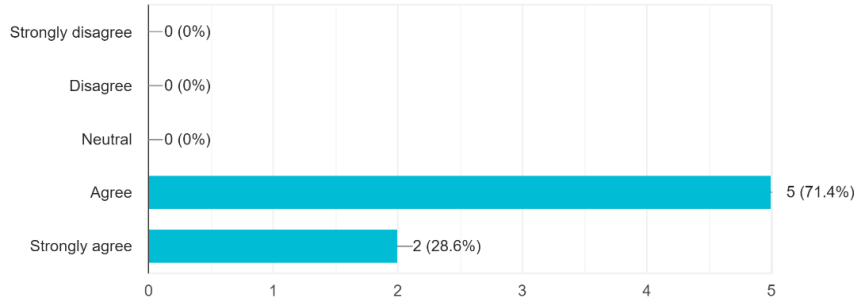

Figure 5-2 Questionnaire responses on streamlining ASM

All the respondents agreed to the PPGM-BMC partnership being a successful pathway to formalizing ASM with approximately 28.6% of the respondents strongly agreeing. Respondents during interviews highlighted successes attained through the partnership in formalising the ASM activities which include;

- The organisation of miners to work under the cooperative structures enhances the protection of miners from the influence of mafia in ASM, commonly known as “mbimbo”.
- Free transportation of ores from the shafts to the PMC encourages the miners to produce under the cooperative to benefit from the discounted cost of production.
- The existence of the partnership allows for the shared responsibilities in collaborating with regulatory authorities and other stakeholders.

Figure 5-3 shows the questionnaire responses from the stakeholders to the LSM-ASM partnership on their perspectives regarding the control of illegal mining.

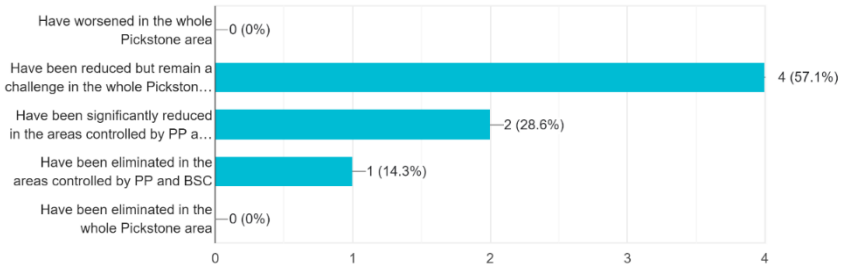

Figure 5-3 Questionnaire responses on control of illegal mining

All the respondents acknowledged the reduction of illegal and unregulated mining activities after the inception of the PPGM-BMC partnership. However, most of the respondents (approximately 57.1%) record that the illegal and unregulated mining activities remain a challenge in the whole Pickstone area. 28.6% of the respondents indicate that there is better control in the tributed mining locations while 14.3% perceive that full control has been gained in areas under the partnership. The interview participants acknowledged the existing orderly ASM activities through the cooperative and the prevailing non-violent engagements between PPGM and artisanal miners. This, they highlighted, was not the case prior to the existence of partnership. However, cases were cited within the cooperative where some shafts were exploited by other miners without consent while the owners were taking seasonal farming breaks. These occurrences undermine the efforts made so far in regularising ASM activities. Local leaders expect the cooperative to rein in its members for the good of the community.

Figure 5-4 shows the opinions of stakeholders on the partnership's environmental and social responsibility.

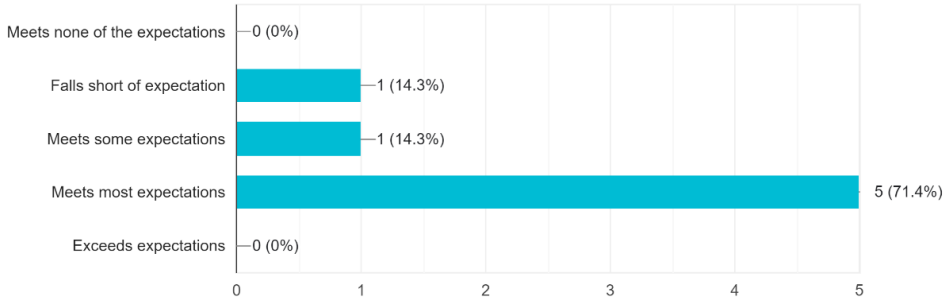

Figure 5-4 Questionnaire responses on environmental and social responsibility

Most of the respondents expressed confidence in the partnership's commitment to environmental and social responsibility, but there is a notable minority expressing

concerns about performance and expectations. 71.4% of the respondents view the mining and processing activities conducted by LSM-ASM collaborations as environmentally and socially responsible. One respondent believes that the performance falls short of their expectations while another respondent acknowledges that some expectations are met. Respondents submitted that, while order prevails within the tributed claims, social ills remain a threat to the local community. These range from hooliganism, commercial sex work, drugs and substance abuse, alcoholism and wanton spending of income which lead to strife and conflicts within families and the community.

Figure 5-5 shows the opinions of stakeholders on sustainable socio-economic outcomes arising from the partnership.

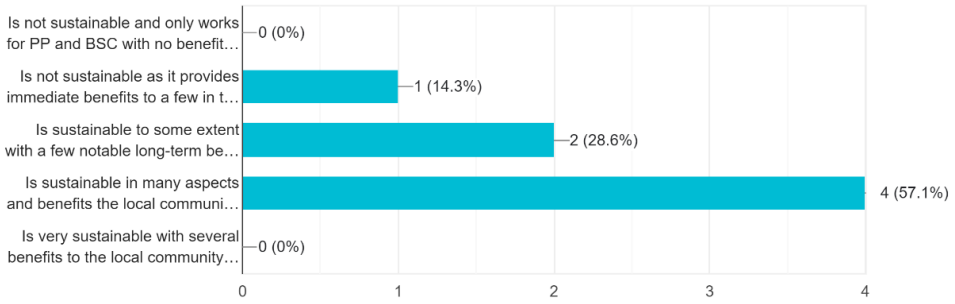

Figure 5-5 Questionnaire responses on sustainable socio-economic outcomes

57.1% of the respondents recognise sustainable outcomes that benefit the local community and the rest of the economy but believe there is room for improvement. 28.6% believe that the outcomes are sustainable to some extent with a few notable long-term benefits realized at local and national level. One respondent does not perceive the LSM-ASM collaboration to be sustainable as it only provides immediate benefits to a few in the local community. Interviewed stakeholders

acknowledged several initiatives benefiting the community, most of which were sponsored by the LSM entity. These include the following:

- Drilling and repair of portable water boreholes for the community around the mine;
- Construction of the Mafuti Clinic expecting mothers' shelter;
- Regular maintenance of the service road from Chegutu to the Ngezi highway via Pickstone;
- Donation of textbooks, stationery, and food to Pickstone and Tiverton Primary Schools;
- Donation of medical supplies and Personal Protective Equipment (PPE) to Chegutu Hospital, Farnham, and Mafuti Clinics and
- Distribution of food hampers to the local traditional leaders.

Figure 5-6 presents the opinions of stakeholders on the inclusion and empowerment of women and youth in mining.

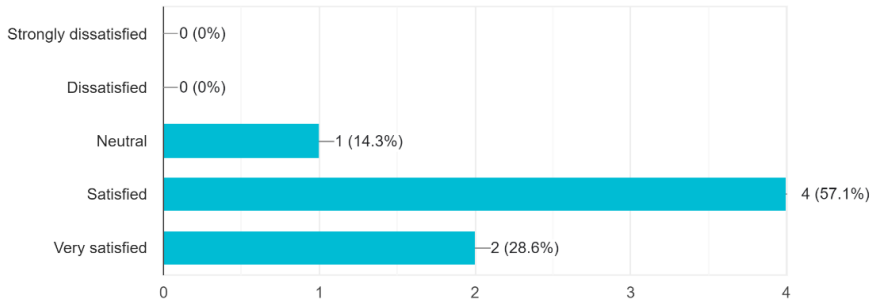

Figure 5-6 Questionnaire responses on social inclusion and empowerment

Most stakeholders (85.7%) showed satisfaction with the combined efforts by PPGM and BMC to promote social inclusion and empowerment of marginalized groups such as women and youths. One respondent indicated neutrality. The following were hailed by the interviewees as positive initiatives by the partnership to support families in the community through women and youth empowerment:

- The women from the community, who are also members of BMC, are engaged to clean up ore spillages (housekeeping) around the plant and they take turns to mill their spillage material to recover free gold.
- The nature of the cooperative and its founding principles inherently support the inclusion of youth in mining. The feasibility study report for the cooperative highlighted that the unemployed youth, who made up the majority of its founding membership, “resorted to register a cooperative to formalise their existence and operations” (BMC, 2015b).

However, myths and customs that prevent women from fully participating in mining underground still exist. Some interviewees stated that participation by women in underground mining brings misfortune to the miners and this was also reported during focus group interactions with the miners. Women are therefore encouraged to indirectly participate in the ASM operations by providing services and sponsoring the miners carrying out the mining activities.

Figure 5-7 presents the opinions of stakeholders on how likely they are to recommend partnerships approach to the formalisation of ASM.

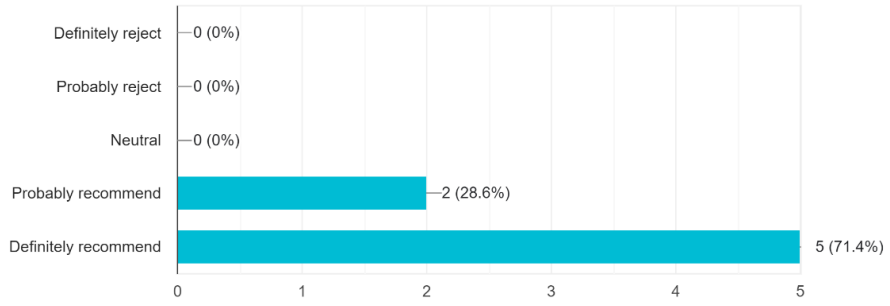

Figure 5-7 Questionnaire responses on the appropriateness of LSM-ASM partnerships to formalise ASM

All the respondents recorded that they would recommend LSM-ASM collaborations such as the PPGM-BMC partnership as an appropriate way to formalise ASM in

Zimbabwe. Stakeholders who were interviewed recommended LSM-ASM partnerships as a pathway to formalisation of ASM for the following reasons:

- LSM-ASM partnerships provide a sense of security in communities as the youth are engaged in legal and regulated mining activities, contributing to safer and more sustainable livelihoods.
- Communities can directly benefit and make a living from the mineral resources they are endowed with.
- Exploitation of mineral resources by the communities provides relief from poverty and hunger in times of economic hardships and drought.
- Formalised ASM provides structured alternative sources of income for the rural households as youths are engaged in mining while the rest of the community continues with subsistence farming for food security. This diversifies and increases economic activity in the rural communities.

5.2.3 Focus group session outcomes

The focus group discussion with BMC miners at Duchess Hill East Shafts revealed valuable insights into their operational dynamics, challenges, and needs. The miners work in groups of five, utilizing limited resources such as compressors, jack hammers, and diesel engines. This necessitates a queuing system to ensure everyone gets a chance to use the equipment, ultimately leading to reduced productivity, with only one blast per day instead of the targeted three. Miners emphasised their resourcefulness, stating, "We take turns to use the machines or queue so that we are all served." However, concerns regarding payment and revenue sharing persist, with the miners highlighting lack of transparency in the company's 10% proceed deduction. This leaves miners with limited earnings, and uneven distribution among miners, where the shaft owner takes half of the money, and the remaining is shared among miners. As one miner expressed, "10% of the

proceeds goes to the company...the owner of the mining shaft takes half of the money, and we will share the remaining amongst ourselves."

The miners emphasized their need for basic amenities like clean water, additional resources. These include compressors, for which they are charged $50 monthly maintenance fee, jack hammers, diesel, and tents, and work suits to enhance their working conditions and safety. Notably, their familiarity with the area and guaranteed income motivate them to stay, despite safety concerns outside the fenced area. As one miner stated, "We already know the place, and now know that we will have something at the end of the day. Outside is dangerous sometimes." Overall, the discussion highlighted the miners' resilience and resourcefulness, while also underscoring the need for improved support and infrastructure to optimize their productivity and well-being.

5.3 Research Findings

An analysis of the research results led to the following findings.

5.3.1 Finding 1

The motivation for forming the LSM-ASM partnership was to:

- *Establish control of ASM activities;*
- *Foster coexistence between the LSM entity and ASM operations and*
- *Regularise ASM for the benefit of the investor, ASM operations and the host community.*

The investor, Breckridge Investments, took the approach of engaging both the traditional and political leadership of the Pickstone and Chegutu community for stakeholder buy-in before commencing LSM operations at PPGM. Breckridge

decided to set up a small-scale mining business unit and allocated it mining claims that hosted marginal deposits and those that are uneconomical for LSM operations but otherwise economic for ASM. This would allow ASM to be employed as the most suitable and economic mining method for marginal deposits while addressing the contention with the community on mining rights. Young people in the community were organized into a mining cooperative which was engaged by Breckridge's ASM business unit as a tributor and major supplier of ore to PMC, with consent from the traditional and political leadership.

The formation of the LSM-ASM partnership achieved the major goals of controlling and regularizing ASM activities in a mining area where the LSM operations were targeted for the greater good of the economy.

5.3.2 Finding 2

The individual goals for PPGM and BMCs' participation in the partnership are being met, however, there are notable areas for improvement.

The existence of this partnership was premised on addressing the individual needs of the agreeing parties. These needs were to:

- Enable LSM operations to be carried out at the Pickstone and Peerless pits, uninterrupted by illegal miners, commonly known as "makorokoza", from the Pickstone and Chegutu communities;
- Create employment and secure alternative means of income for the unemployed youths through a formalised mining cooperative society and
- Operate a viable ASM business with the cooperative as the major supplier of ore for processing under a "free gold" business model.

Figure 5-8 shows PPGM's production profile from the time LSM operations commenced in 2015 to 2023.

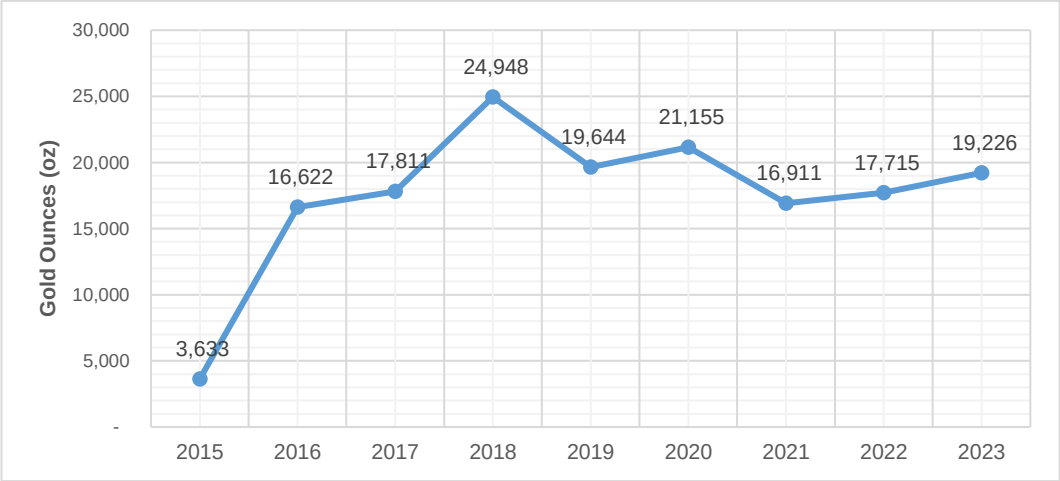

Figure 5-8 Gold production from PPGM's LSM operations (Dallaglio, 2024b)

Despite isolated skirmishes with illegal miners especially on night shifts, PPGM has managed to run its LSM operations uninterrupted since 2015 as reflected in the gold production profile. A record-high gold production for PPGM was achieved at 25,000 ounces in 2018 while the company was operating 2 open pit mines, i.e., the Pickstone and Peerless pits. **Figure 5-9** shows BMC's monthly ore supply profile between 2021 and 2023.

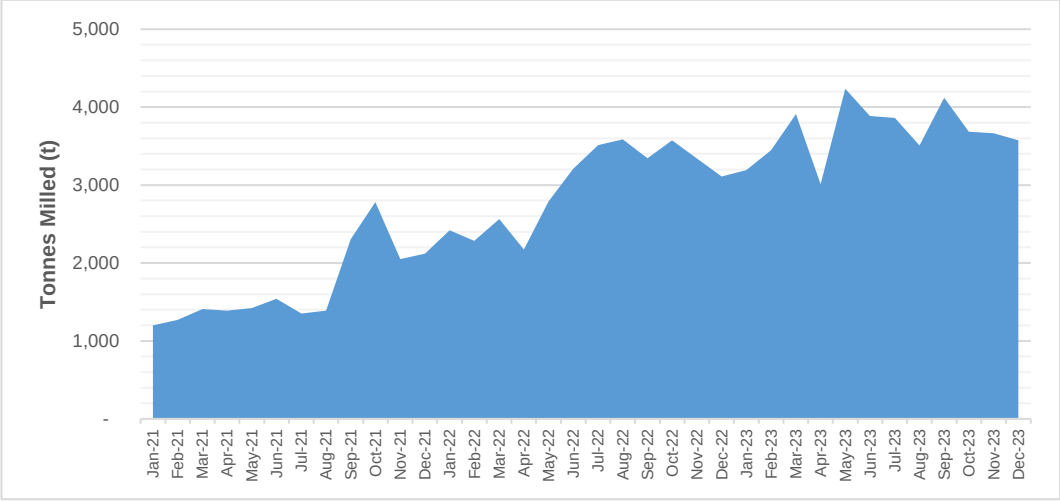

Figure 5-9 Ore supply from BMC miners to PMC (Dallaglio, 2024c)

In line with Cordillera's expectations, BMC has consistently supplied ore from the Bluestreak claims to PMC since its formation despite suffering occasional disruptions common to mining such as water accumulation in shafts, loss of reef

caused by geological structures, and poor grades. BMC's membership has grown from 86 at inception to 240 by end of December 2023 as Cordillera availed more claims under the tribute agreement. This has created more employment opportunities for the youths in the local community through a formalised ASM cooperative over the life of this partnership. The number of claims allocated to BMC has increased from 4 to 17 claims between 2015 and 2023 which shows the strength of the relationship between the two parties.

From the interviews and focus group discussions, it was understood that the ASM operations expect to sell their free gold at prevailing market prices to maximise their returns. Cordillera has responded to this by engaging a dedicated third-party buyer to purchase the miners' free gold on site under the Cordillera gold buying license which removes the cash risks from Cordillera. The buyer purchases the free gold at market prices, less a sales commission which is standard in most ASM operations in Zimbabwe. Cordillera retains the gold and delivers the bullion together with its cyanide gold recovered from the tailings to Fidelity Printers and Refiners (FPR). This arrangement discourages side marketing to outside traders and prevents leakages of gold that should accrue to the state for the nation to benefit.

5.3.3 Finding 3

The LSM-ASM partnership has streamlined ASM activities within the Pickstone community into formalised operations.

The existence of the LSM-ASM partnership has created an avenue for ASM activities to be formalised and regulated through the formation of a registered mining cooperative society. The processes of forming a mining cooperative,

registering a tribute agreement, and carrying out actual mining are guided by the following key legislation in Zimbabwe:

- Societies Act (Chapter 24:05);
- Environmental Management Act (Chapter 20:27) and
- Mines and Minerals Act (Chapter 21:05).

These and other pieces of legislation are administered by relevant government ministries to streamline the ASM activities in accordance with the law. Data review indicates that both PPGM and BMC have shared responsibilities in engaging with the regulatory authorities and stakeholders. **Table 5.1** maps the existing relationships between the PPGM-BMC partnership and its stakeholders, identifying the responsible party for building and sustaining each relationship.

Table 5.1 PPGM-BMC stakeholder relationships

Stakeholder	**Party responsibility for engagement**	
	PPGM	**BMC**
EMA	✓	X
MMMD	✓	✓
CRDC	✓	X
ZRP	✓	X
Traditional leadership	✓	✓
Political leadership	X	✓

PPGM, as the grantor of the tribute, is involved in engaging and maintaining sustainable relationships with all regulatory authorities and the local leadership. BMC can therefore leverage on the existing relationships between PPGM and its stakeholders for ease of doing business. BMC also engages directly with the MMMD on its legal and regulatory obligations as a tributor and takes full responsibility of managing the partnership's relationship with political leaders.

5.3.4 Finding 4

The PPGM-BMC partnership has reduced illegal and unregulated mining activities in the Pickstone area.

The creation of a small-scale mining business unit under Cordillera has been effective in addressing illegal ASM activities all over Breckridge's mining claims. The mine acknowledges the reduction in illegal mining within its claims. However, its security department continues to run battles with some rogue individuals or groups operating outside of the partnership's framework, engaging in illegal mining activities and disregarding safety, security, and regulatory protocols.

Consultations with stakeholders revealed that there is a general agreement among stakeholders that illegal and unregulated ASM activities have significantly reduced around Pickstone since the formation of the LSM-ASM partnership. The membership structure of the cooperative has been successful in regulating the influx of miners from other regions within BMC's areas of operation. However, in-migration remains an unresolved issue in regions outside the partnership's control.

5.3.5 Finding 5

Efforts to make extractive processes environmentally and socially responsible were recognised but opportunities for improvement exist.

Control of mining operations is under the BMC leadership while processing operations are controlled by the PMC management. These responsibilities are outlined in the tribute agreement to avoid ambiguity. The PMC management periodically inspects the ASM operations around the tributed mining claims, advising the miners on safe mining practices. The BMC miners have maintained a good safety record so far with no fatality or life-threatening injuries being reported since the partnership's inception. PPGM is frequently involved in mine rescue

operations around the greater Pickstone and Chegutu area whenever artisanal miners are trapped underground.

The use of mercury by the miners to maximise free gold recovery remains a cause for concern, given the negative impacts of mercury on human beings, animals, and the environment. A review of the gold recovery process at PMC shows that mercury is used by the BMC miners only from the point of gold concentration in the separator to burning of amalgam. The amalgamation process is undertaken by the miners after gravity separation and sending the tailings to the settling tanks. Mercury is therefore handled by the BMC miners through the free gold recovery route and does not report to main CIL plant with the tailings. While the risk of mercury exposure is limited to the ASM operations, it remains the responsibility of both PPGM and BMC to put measures that reduce emissions and releases of, and exposure to, mercury.

The major impacts on the environment that arise from the ASM activities are land degradation, deforestation, and contamination of water sources. The allocation of multiple shafts to small groups of miners as a strategy to individualise both performance and reward leads to significant landscape alterations which require rehabilitation after mining. Miners use timber acquired from neighboring farms to construct timber sets for the support and protection of their shafts in weak ground zones. There is no significant involvement by the BMC miners in PPGM's reforestation efforts which are part of its commitment to environmental conservation.

Rehabilitation of disused shafts remains a challenge despite efforts by the cooperative to clearly identify and backfill them. Shafts are closed once grades have diminished or the reef has become uneconomic to mine, or ground conditions

have deteriorated to become unsafe to continue mining. The challenge arises when backfilling is initiated, and miners claim that the shafts are still productive after abandoning them for long periods of time and this hampers rehabilitation efforts.

The mine faces a significant risk by not having complete control over ASM activities at the shafts, as it may be left with sterilised orebodies and substandard shafts that pose a hazard to miners, livestock, and the local community once the tribute agreement expires. During the existence of the agreement, the tributor bears the risk, but it effectively shifts to the grantor (the mine) upon termination, at which point the mine becomes responsible for closing and backfilling the shafts to prevent potential harm. PPGM is also implementing global tailings management standards in managing the tailings from PMC and the main plant which is a commitment over and above the legislative requirements.

5.3.6 Finding 6

The PPGM-BMC partnership has notable socio-economic outcomes benefitting the community but needs to gear towards more sustainable interventions.

The investment by Breckridge in both LSM and ASM business ventures centered around the Pickstone and Chegutu communities reflects its commitment to contribute to sustainable socio-economic development in the region. The LSM is employing from the local community, unskilled labour and other relevant skills depending on availability. Skilled, professional, and managerial employees are drawn from the national pool of human resources based on merit. The total employment by the LSM operations is 1,240 employees including contractors and membership under BMC is currently at 240 miners. This employment strategy allows the mine to operate its assets with high efficiency while providing synergies

with the local community to upskill the population for future engagements elsewhere.

Overall, the investment into the Chegutu district has increased economic activity in the community and the benefits extend beyond the region. The ASM operations under Cordillera contribute 8% of Breckridge's total gold production which assisted Breckridge in posting total revenue of US$34 million in 2023. Salaries and wages are 32% of Breckridge's total operating expenditure, which directly benefit employees. Breckridge also invested up to US$280,000 in Corporate Social Responsibility (CSR) initiatives covering healthcare, education, sports and environmental management in 2023[7]. The existence of an LSM operation in the community has positive impact on the local GDP. This is necessitated by new employment opportunities, procurement and trade linkages, training and development of new skills, upskilling and multiskilling of locals to be competitive regionally, nationally and internationally. These commitments position both the LSM and ASM business ventures to impact the economy positively. BMC has also taken up some initiatives at Pickstone Primary School which include;

- Donation textbooks and stationery;
- Replacement of broken windowpanes on classroom blocks and
- Providing overnight security at the school at the cooperative's own cost.

Some stakeholders, however, registered displeasure at the lack of growth in the cooperative's capacity to adequately resource the mining activities of its members. During the site visit, this was confirmed as the miners are struggling to achieve their daily targets while sharing 1 compressor and jackhammer set. The miners

[7] Internal company document: Breckridge Investments FY2023 Financial Report.

take turns to drill holes for blasting using the available equipment and some groups fail to blast after waiting all day. This is a result of lack of reinvestment by BMC to sustain production and increase the possible returns to the miners which, in turn, spurs economic activity in the area.

5.3.7 Finding 7

The partnership promotes social inclusion, women and youth empowerment at various levels.

The fundamental objective behind the formation of the BMC was to provide an alternative form of employment for the unemployed youths who were normally involved in illegal ASM. The engagement of BMC by PPGM to operate in its mining claims as a tributor fulfilled the aspiration of the cooperative to empower the youths and women. The women in the community who are BMC members are engaged in groups by the PMC to hand sort low-grade ores stockpiled from LSM operations for processing at PMC. The participating women are paid from the free gold they retain and sell to Cordillera, and this encourages them to provide quality hand-sorted ores to maximise returns.

5.3.8 Finding 8

LSM-ASM partnerships are highly recommended as a pathway for the formalisation of ASM.

The Cordillera small-scale business entity proves to be a strategic unit to the success of LSM operations at PPGM and for the profitability of the Breckridge business. Such a partnership allows both the business investor, the local community, and the nation as a whole to obtain a share of the economic rent from the natural resources is host communities.

5.4 Discussion of Findings

The findings from the research on the LSM-ASM partnership between PPGM and BMC align with existing literature on the "partnerships approach" to formalizing ASM. The partnership's primary motivation was to establish control, foster coexistence, and regularize ASM activities, achieving major goals of controlling and formalizing ASM. While individual goals are being met, areas for improvement exist. The partnership has streamlined ASM activities into formalized operations, reduced illegal mining, and promoted environmental and social responsibility, although opportunities for improvement remain. Notably, the partnership has generated socio-economic benefits for the community, empowered women and youth, and is recommended as a pathway for ASM formalization. These findings support existing literature highlighting the benefits of LSM-ASM partnerships, including improved regulation, enhanced socio-economic outcomes, increased environmental and social responsibility, and empowerment of marginalized groups. The research reinforces the potential of LSM-ASM partnerships to formalize ASM, promote sustainable development, and improve socio-economic outcomes for local communities.

5.5 Theoretical Framework for Future Partnerships

Based on the findings from this research, a Harmonious Coexistence Framework (HCF) is proposed to foster a symbiotic relationship between LSM and ASM operations. This approach ensures a sustainable future for mining in the region and is built on the following pillars:

- *Autonomy and Capacity Building:* Empowering ASM operators to manage their own affairs, develop entrepreneurial skills, and enhance technical capabilities.

- *Clear Accountabilities and Governance:* Establishing well-defined roles, responsibilities, and accountabilities throughout the gold value chain, guided by a comprehensive tribute agreement and regulatory frameworks.
- *Scalability and Flexibility:* Encouraging a scalable business model that adapts to changing circumstances, ensuring the partnership remains viable and sustainable.
- *Mutual Benefit and Win-Win Approach:* Fostering a collaborative environment where both LSM and ASM operations benefit, ensuring a fair distribution of value and incentives for cooperation.
- *Sustainable Practices and Environmental Stewardship:* Promoting environmentally responsible practices, minimizing harm, and ensuring compliance with international standards and conventions.
- *Innovative Solutions and Continuous Improvement:* Encouraging innovation, research, and development to address challenges, improve processes, and enhance the partnership's overall effectiveness.

The HCF framework contributes to the literature by providing a structured approach to LSM-ASM partnerships, emphasizing the importance of autonomy, clear governance, scalability, mutual benefit, sustainable practices, and continuous improvement. This framework can serve as a model for future partnerships, ensuring a harmonious coexistence between LSM and ASM operations.

5.6 Chapter Summary

This chapter has dealt with research results and detailed analysis of the research data and relevant findings were drawn from the analysis. These findings were addressing the various research questions posed in this study to arrive at plausible

conclusions about LSM-ASM partnerships as a suitable route to ASM formalisation. The following were the findings:

- The partnership achieved its primary goals of controlling and formalizing ASM activities.
- The individual goals for PPGM and BMCs' participation in the partnership are being met, however, there are notable areas for improvement.
- The partnership has streamlined ASM activities into formalised operations, reduced illegal and unregulated mining activities in the Pickstone area.
- Efforts to make extractive processes environmentally and socially responsible were recognised but opportunities for improvement exist.
- The partnership has notable socio-economic outcomes benefiting the community but needs to gear towards more sustainable interventions.
- The partnership promotes social inclusion, women and youth empowerment at various levels.
- LSM-ASM partnerships are highly recommended as a pathway for the formalisation of ASM.

Based on these findings, the Harmonious Coexistence Framework (HCF) is proposed to foster a symbiotic relationship between LSM and ASM operations. HCF is built on six pillars:

- Autonomy and Capacity Building
- Clear Accountabilities and Governance
- Scalability and Flexibility
- Mutual Benefit and Win-Win Approach
- Sustainable Practices and Environmental Stewardship
- Innovative Solutions and Continuous Improvement

The HCF framework contributes to the literature by providing a structured approach to LSM-ASM partnerships, emphasizing the importance of autonomy, clear governance, scalability, mutual benefit, sustainable practices, and continuous improvement. This framework can serve as a model for future partnerships, ensuring a harmonious coexistence between LSM and ASM operations.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter summarises the research on the case study of a typical LSM-ASM partnership to provide practical alternatives to the formalisation of ASM in Zimbabwe. The PPGM and BMC partnership was examined to evaluate its potential as a model for formalizing ASM. The focus was on objectives of the partnership, alignment with stakeholders' goals, impact on illegal mining, management of ASM activities and its contribution to socio-economic sustainability.

6.2 Summary of Chapters

This report presents a comprehensive study on the effectiveness of LSM-ASM partnerships in formalizing ASM and capturing economic benefits for communities and nations. The six chapters of this study, using the PPGM-BMC partnership as a case study, explores the tensions and conflicts between LSM and ASM players, and examines the literature on LSM-ASM partnerships, research methodology, data collection and analysis, and findings. The report finds that formalizing ASM through LSM-ASM partnerships is beneficial and provides insights into the successes and challenges of such collaborations. The study concludes by summarizing key observations, contributions, limitations, and recommendations for future research, offering a valuable resource for understanding the complex dynamics of LSM-ASM partnerships and their potential for socio-economic development.

6.3 Key Findings and Observations

The key findings from the study supported the establishment of LSM-ASM partnerships as an alternative pathway to formalize ASM operations in Zimbabwe. The primary motivations for these partnerships include controlling ASM activities, fostering coexistence between LSM and ASM players, and regularizing ASM to benefit both the investing LSM company, host communities and the rest of the nation. The PPGM-BMC collaboration has successfully formalized ASM activities in the Pickstone area and curtailed illegal mining. Good rapport was established between the business and the miners and disruptions to production were reduced to a minimal. The partnership has also been recognized for making mining processes more environmentally and socially responsible, although further enhancements are possible. Socio-economic benefits for the community have been significant, but there is a need for more sustainable initiatives that have long term and far-reaching benefits to a wider population. Additionally, the partnership has been instrumental in promoting social inclusion and empowering women and youth. Overall, LSM-ASM partnerships are strongly endorsed as a strategy for the formalization of ASM, suggesting a positive impact on the mining sector and the broader community.

Among the observations made during the research, the lack of resources to support production by the ASM operations was prominent. It was observed that the miners are not adequately equipped to be more productive as they mine and this is arising from the lack of reinvestment by the cooperative to resource the miners. The use of mercury in ASM operations remains a challenge to the health and safety of the miners which requires alternative methods to be pursued.

6.4 Research Contributions

The case study has contributed to the theory of formalisation of ASM through the LSM-ASM partnerships. The benefits of the "partnerships" approach were demonstrated by the regularisation of ASM to create a peaceable operating environment for both the mining entities and the community. The significance of ASM remains prominent in Zimbabwe given the prevailing economic situation. This study has shown a practical pathway of instituting a sustainable ASM business model which involves the host communities and the LSM entity seeking to invest in mineral exploitation. The shift from informality and illegality to formal and legally recognised ASM operations has many benefits which have been demonstrated in this study. These include the curbing of gold leakages to parallel markets which deprives the state of potential revenue, economic exploitation of marginal ore deposits and the creation of alternative sources of livelihood for the communities endowed with mineral resources.

This study proposes the HCF, a structured approach to foster symbiotic LSM-ASM relationships, ensuring sustainable mining practices. The HCF framework addresses the knowledge gap in LSM-ASM partnerships by providing a comprehensive model that prioritizes cooperation, sustainability, and mutual benefit. This contribution enhances the existing literature on mining partnerships, offering a valuable resource for policymakers, practitioners, and researchers. The HCF framework has the potential to enhance LSM-ASM relationships, promote sustainable mining practices, foster entrepreneurship and community development and inform policy and regulatory frameworks. Ultimately, this research establishes a foundational framework for future studies on LSM-ASM partnerships, contributing to the development of more effective and sustainable mining practices.

6.5 Recommendations from the Study

To address the gaps identified in the LSM-ASM partnership, a comprehensive approach is recommended. This includes implementing alternative gold extraction methods to eliminate mercury use, developing environmental rehabilitation plans, and establishing a long-term sustainability plan that encompasses economic, social, and environmental aspects. Additionally, providing access to affordable equipment and resources, offering regular training and capacity building programs, and promoting entrepreneurship and business development in the local community can help address equipment and resource constraints and enhance capacity building. Strengthening stakeholder engagement through regular meetings and forums and promoting women and youth empowerment through targeted programs and mentorship initiatives can also improve the partnership's outcomes. By addressing these gaps, the LSM-ASM partnership can optimize its socio-economic and environmental impacts, promote sustainable mining practices, and ensure a harmonious coexistence between LSM and ASM operations.

6.6 Recommendations for Future Research Work

The dynamics of LSM-ASM relationships were observed to be centred on the quality of the mineral resource, particularly, the availability and abundance of free gold. ASM operations are more attracted to oxidised ores which yield more free gold than other ore types. Oxides tend to deplete with increased depth as sulphides become prominent at depth. This study was focused on the “free gold” model as the basis for LSM-ASM collaboration. A different model can be applied to foster LSM-ASM partnerships where the mineral deposit presents more sulphides with less liberated gold. Future research is therefore recommended for an appropriate

economic model for gold ores with less free gold, for instance, an ore purchase model at varying grades.

Another area to explore through research is the significance of the LSM-ASM co-existence model can support the transition away from mercury use. The strengths and resources of LSM can be leveraged to improve ASM practices through, for instance, technical assistance, technology transfer, and financial resources to help ASM operations adopt mercury-free extraction methods. These partnerships can also foster the implementation of best practices for environmental management and worker safety, which are often more established in LSM operations. By sharing knowledge and resources, LSM can help ASM miners understand the health risks associated with mercury and train them in alternative techniques. Furthermore, LSM-ASM collaborations can advocate for policy changes that promote mercury-free mining and support the objectives of the Minamata Convention on Mercury. Such collaborations are essential for creating sustainable mining practices that not only protect the environment but also improve the livelihoods of ASM communities.

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APPENDIX A. ETHICS CLEARANCE DOCUMENTATION

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

Registration number: REC-101114-044

SCHOOL OF MINING ENGINEERING ETHICS COMMITTEE

Ethics clearance / waiver number: EMINN/2023/101

13 December 2023

RE: Vincent Tsoriyo (2414413)

To whom it may concern,

Vincent Tsoriyo (2414413) is currently registered as a ECA00 – Masters by Coursework student at the School of MINING ENGINEERING, University of the Witwatersrand, Johannesburg. This letter is to confirm that, at the time of writing, *Vincent Tsoriyo* does need ethical clearance for his/her study entitled '*LARGE-SCALE MINING (LSM) AND ARTISANAL AND SMALL-SCALE MINING (ASM) LINKAGES FOR SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT IN ZIMBABWE*'.

This decision has been reached based upon a description of the project supplied by *Vincent Tsoriyo* to the School of Mining Engineering Ethics Committee, constituted as a subcommittee of the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the subcommittee chair. This decision has then been ratified by the University Human Research Ethics Committee (Non-Medical). If, however, ***Vincent Tsoriyo*** changes the methods of data collection and analysis for this project, this decision may no longer be valid. If such changes take place, this should be communicated to the School of Mining Engineering Ethics Committee.

Please feel free to contact me should you require any further information.

Thank you.

Yours sincerely,

Mr. Huw Thomas
School Ethics Chair Person

Shaun Schoeman (Senior Administrative Officer)
Solomon Mahlangu House, 10th Floor, Room 10004, Jorissen Street, Braamfontein, Johannesburg
Private Bag 3, Wits 2050
T + 27(0)11 717 1408 | E Shaun.Schoeman@wits.ac.za | hrecnon-medical@wits.ac.za
www.wits.ac.za/research/about-our-research/ethics-and-research-integrity/

Consent Form

Title of Project: Large-Scale Mining (LSM) and Artisanal and Small-Scale Mining (ASM) linkages for sustainable socio-economic development in Zimbabwe

Name of Researcher: Vincent Tsoriyo

I, S. MUTEMA....., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	~~YES~~	NO
I understand that I can volunteer to take part in the study.	~~YES~~	NO
I agree that the interview/focus group/other activity may be audio recorded.	~~YES~~	NO
I agree that direct quotations from my interview/focus group/other activity may be used by the researcher in their research report.	~~YES~~	NO
I agree that my participation will remain anonymous (my name will not be used by the researcher in their research report).	~~YES~~	NO
I agree that other researchers may use the information I provide in my interview/focus group/other activity (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on.	~~YES~~	NO

..... (signature)

..... (name of participant)

13/02/2024 (date)

..... (signature)

VINCENT TSORIYO (name of researcher/person seeking consent)

13/02/24 (date)

Consent Form

Title of Project: Large-Scale Mining (LSM) and Artisanal and Small-Scale Mining (ASM) linkages for sustainable socio-economic development in Zimbabwe.

Name of Researcher: Vincent Tsoriyo

I, Tendai Chihuri, agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	(YES)	NO
I understand that I can volunteer to take part in the study.	(YES)	NO
I agree that the interview/focus group/other activity may be audio recorded.	(YES)	NO
I agree that direct quotations from my interview/focus group/other activity may be used by the researcher in their research report.	(YES)	NO
I agree that my participation will remain anonymous (my name will not be used by the researcher in their research report).	(YES)	NO
I agree that other researchers may use the information I provide in my interview/focus group/other activity (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on.	(YES)	NO

..... (signature)

Tendai Chihuri ..... (name of participant)

29/12/2023 ..... (date)

..... (signature)

Vincent Tsoriyo ..... (name of researcher/person seeking consent)

29 December 2023 ..... (date)

DALLAGLIO

Dallaglio Investments (Pvt) Limited
121 Borrowdale Road, Gunhill, Harare, Zimbabwe
info@dallaglio.co.zw

University of Witwatersrand
School of Mining Engineering
Private Bag 3, WITS 2050
Johannesburg, South Africa

Attention: Mr. Vincent Tsoriyo

2 November 2023

Dear Sir,

RE: Permission to conduct research at Pickstone Peerless Mine

Your interest to do a case study of the Pickstone Peerless Mine – Blue Streak Cooperation partnership, under the research title **"Large-Scale Mining (LSM) and Artisanal and Small-Scale Mining (ASM) linkages for sustainable socio-economic development in Zimbabwe"**, refers.

We are pleased to inform you that your request to conduct research with our company data has been approved. We appreciate your interest in our work and we are looking forward to seeing the results of your study.

You will have access to the data for the duration of your studies, starting from the date of this correspondence. You will also need to adhere to the ethical and confidentiality guidelines provided by our company and your school. Please do not share, copy, or modify the data without our prior consent.

We hope that this collaboration will be beneficial for both parties and that it will lead to new insights and innovations. If you have any questions or concerns, please do not hesitate to contact us.

Yours sincerely,

For and on behalf of Cordillera Investments.

Stew Cameron
General Manager

APPENDIX B. PHOTOGRAPHS FROM THE SITE VISIT

A site reconnaissance visit to the ASM operations was done on the 22nd of February 2024 at PPGM in Chegutu, Zimbabwe. Photographs were taken of the set up and various activities along the gold value chain for the miners.

Figure B1 Picture of an exploration pit

Figure B2 Picture of a small-scale miner's shaft

Figure B3 Picture of timber sets for shaft support

Figure B4 Picture of a compressor for powering mining equipment

Figure B5 Picture of an 8t tractor dumper for ore transportation

Figure B6 Picture of an ore stockpile awaiting processing

Figure B7 Picture of the PMC crushing section

Figure B8 Picture of the 15t surge bins with fine ore

Figure B9 Picture of the PMC milling section

Figure B10 Picture of a round mill

Figure B11 Picture of the panning bay

Figure B12 Picture of the holding tank for tailings to the CIL plant