The impact of mine closures and unrehabilitated mines on the surrounding Klerksdorp communities

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Examination: March 2025

DECLARATION

I Kagiso Maruping declare herewith that the mini-dissertation entitled The impact of mine closures and unrehabilitated mines on the surrounding Klerksdorp communities, which I herewith submit to the North-West University in partial compliance with the requirements set for the degree: Master of Business Administration is my own work, has been text-edited in accordance with the requirements and has not already been submitted to any other university.

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ABSTRACT

The closure of mines and the prevalence of unrehabilitated mining sites have significant environmental, economic, and social repercussions for host communities. This study investigates the impacts of mine closures and unrehabilitated mines on the Klerksdorp communities, focusing on environmental hazards, socioeconomic challenges, policy shortcomings, and potential pathways for sustainable development. Semi-structured interviews were conducted with diverse stakeholders, including local residents, community leaders, and mining representatives, to explore the lived experiences and perceptions of affected populations. The findings highlight severe environmental degradation, characterised by water pollution, air quality deterioration, and loss of arable land. These hazards have adversely affected health outcomes, agricultural productivity, and access to clean water, disproportionately affecting marginalised communities near mining sites. Economically, mine closures have exacerbated unemployment, reduced household incomes, and destabilised local businesses, intensifying poverty in already vulnerable areas. Despite South Africa's comprehensive policy framework, enforcement and accountability remain inadequate, with rehabilitation measures often limited to superficial interventions. To address these challenges, the study recommends strengthening policy enforcement through an independent regulatory body, establishing mandatory rehabilitation funds, and aligning mining practices with the United Nations Sustainable Development Goals (SDGs). Community engagement emerged as a critical component, advocating for inclusive decision-making and leveraging local labour in rehabilitation projects. Furthermore, investment in alternative livelihoods and sustainable industries is essential to revitalise the local economy. The study also identifies significant gaps, including the lack of quantitative environmental data, limited geographic scope, and insufficient analysis of stakeholder dynamics, which constrain the generalisability of findings. Future research should adopt a mixed-methods approach, expand to other mining regions, and evaluate innovative rehabilitation technologies. This research underscores the urgent need for collaborative, sustainable strategies to mitigate the adverse impacts of mine closures and unrehabilitated sites, promoting resilience and equity in affected communities.

Key terms: Mine closures, unrehabilitated mines, environmental degradation, socioeconomic impacts, Klerksdorp, sustainable development.

LIST OF ABBREVIATIONS

SDGs	Sustainable Development Goals
MPRDA	Mineral and Petroleum Resources Development Act
GDP	Gross Domestic Product
EMP	Environmental Management Programme
DMRE	Department of Mineral Resources and Energy
IDP	Integrated Development Plans
SLP	Social and Labour Plans

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CHAPTER 1: SCOPE AND THE NATURE OF THE STUDY

1.1 Introduction

Klerksdorp is a town in the North West Province of South Africa, specifically in the Dr Kenneth Kaunda District Municipality. Travelling southwest on the N12 Treasure Route from Johannesburg for around 165 km will bring you into the City of Matlosana, the new name for the municipal region formerly known as Klerksdorp. The municipality is a category B municipality that consists of the towns of Klerksdorp, Orkney, Stilfontein, and Hartebeesfontein.

The introduction section establishes the significance of understanding the aftermath of mining operations, emphasising the complex interplay of economic, social, and environmental challenges that arise post-closure. The main points highlight the primary objective of the research, which is to explore the impact that mine closure has in the Matlosana area; this will include socio-economic impacts on households reliant on mining for their livelihoods and the environmental hazards posed by unrehabilitated mining sites.

Mining operations have played a major role in defining the economic and social landscape of several South African settlements, notably the town of Klerksdorp. Although these efforts have resulted in the creation of job opportunities and the advancement of the economy, they have not been devoid of negative consequences. There are big health, social, and environmental problems in the areas where gold mining used to happen, especially in areas that are close to mines that have not been fixed up or that have been affected by mine closures (Sibanda, 2021). This research looks at what happens when mines close and there are still mines in the Matlosana region that have not been fixed up. It does both a full analysis of the body of recent research and a review of case studies that have been done in the area.

South Africa's economic growth has counted on mining towns like Matlosana for a long time. These towns have been the engines of industrialization and urbanization. The area used to be a hub for gold mining that greatly increased the country's wealth, but now mining is decreasing (Cole and Broadhurst, 2020). However, the drop in mining in these places has caused problems for people and the environment. Mine closings often happen during economic downturns that leave people without jobs and make towns less stable (Makgetla et al., 2019). This shows how fragile single-industry economies are. When mine stops, the area is not fixed up, which makes the damage to the environment worse and puts people's health at great risk (Sibanda, 2021).

The area around Matlosana has a past that is linked to how well the mining business did. Still, the area's business and social life are changing a lot now that mine jobs are gone. This change will affect households that relied on mines for direct employment and auxiliary economic opportunities supporting local industries. Without mining, these towns face social instability, economic upheaval, and increased poverty and inequality (Makgetla et al., 2019). Socioeconomic consequences go beyond employment losses to damage community cohesion and social conflicts. The environmental pressures from unrehabilitated mining sites continue. These abandoned mines contribute to public health crises by releasing pollutants into local water supplies, soil, and air, which spread respiratory and waterborne diseases and harm local populations.

Mining still shapes many towns, giving industry and lawmakers opportunities to handle problems and challenges. This difficult legacy shows corporate responsibility and governance system flaws due to decades of negligence on rehabilitation initiatives (Kuipa, 2023). The Mineral and Petroleum Resources Development Act supports stricter rehabilitation duties, but South Africa's legislative climate has altered, and these regulations have been ignored (Mpanza, Adam, and Moolla, 2021). Sometimes this gap cannot be closed since of a lack of resources, bad management, or competing economic goals, which leaves important rehabilitation projects unfinished. So, strong, doable steps are still needed to make sure that current rules are followed and to encourage long-term community growth. These methods need to find a balance between different groups' competing interests in order to fix past mistakes and provide long-term growth paths for those who have been affected, leading to long-term progress and resilience.

Matlosana's unrepaired and closed mines are being examined. This study looks at the environmental and social implications of these closures as well as the current policy structure and attempts to improve it. This study examines Matlosana's challenges in helping communities migrate away from mining economies and strengthen policy and business practices. This study is very important for figuring out how to turn abandoned factories into long-term growth opportunities for other mining towns in South Africa and beyond, using knowledge from the area to guide future steps.

The Sustainable Development Goals (SDGs) deal with global problems like protecting the environment, making sure everyone is healthy, and making sure the economy can keep going. These goals give us a way to think about and handle mine closures (Cole & Broadhurst, 2021). As part of this study, how do current practices fit in with these global

goals? It supports policies that limit harm and encourage a fair and long-lasting shift for Matlosana's affected community.

1.2 Background to the study

Gold mining villages like Klerksdorp in South Africa illustrate the greater historical and socio-economic stories of mining settlements. Its decades-long gold relationship in the North-West Province symbolises South Africa's natural resource participation. The mining operations in this area were once regarded as a significant catalyst for economic expansion, serving as a vital source of wealth for Klerksdorp. The changes in the relative contributions from different industries as the mining operations in the area decreased are depicted in Figure 1. However, behind the surface appearance of wealth, the consequences of mining are intricately connected to a range of difficulties, many of which endure even after mining activities have ceased (Sibanda, 2021).

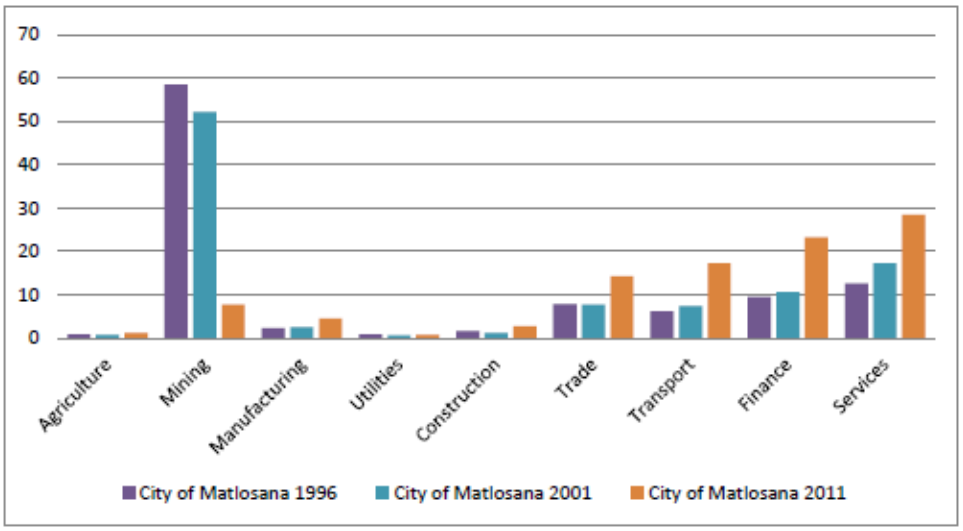


Figure 1.1: GDP – Matlosana, Dr KK District, NW and National Total, 2007-2017

(Source: IHS Markit Regional Explorer Cited by Matlosana IDP, 2022/23)

Based on projections from the Matlosana Socio-Economic Report and the population growth rate of 1.04% provided by SA Statistics, the City of Matlosana is home to 438,486 people, of which 35,079 (8%) are rural and 103,407 (92%) are urban. The urban areas include the mining communities. Jouberton (31%), Kanana, Khuma, and Tigane, which together account for 67% of all urban residents, have the highest population concentrations. With 123 inhabitants per km², 92% of the population of the City of Matlosana lives in urban areas and 8% in rural areas (City of Matlosana IDP, 2022:6).

In terms of its overall contribution to the GDP of the Dr. Kenneth Kaunda District Municipality, the City of Matlosana Local Municipality ranked highest among all the regional economies, with a total GDP of R 33.7 billion in 2017 (City of Matlosana IDP, 2022:7)

GROSS DOMESTIC PRODUCT (GDP) - CITY OF MATLOSANA, DR KENNETH KAUNDA, NORTH-WEST AND NATIONAL TOTAL, 2007-2017 [R BILLIONS, CURRENT PRICES]

	City of Matlosana	Dr Kenneth Kaunda	North-West	National Total	City of Matlosana as % of district municipality	City of Matlosana as % of province	City of Matlosana as % of national
2007	18.7	29.9	120.7	2,109.5	*62.5%*	*15.5%*	*0.89%*
2008	20.5	33.0	138.9	2,369.1	*62.2%*	*14.8%*	*0.87%*
2009	21.4	34.5	147.9	2,507.7	*61.9%*	*14.5%*	*0.85%*
2010	22.9	37.5	164.5	2,748.0	*61.0%*	*13.9%*	*0.83%*
2011	26.4	43.1	185.8	3,023.7	*61.3%*	*14.2%*	*0.87%*
2012	27.5	45.5	191.0	3,253.9	*60.6%*	*14.4%*	*0.85%*
2013	30.3	50.4	222.2	3,540.0	*60.1%*	*13.6%*	*0.86%*
2014	30.1	51.1	226.5	3,805.3	*59.0%*	*13.3%*	*0.79%*
2015	32.0	54.8	243.0	4,051.4	*58.5%*	*13.2%*	*0.79%*
2016	33.5	57.7	255.9	4,350.3	*58.0%*	*13.1%*	*0.77%*
2017	33.7	59.3	275.2	4,651.8	*56.9%*	*12.3%*	*0.72%*

Figure 1.2: GDP – Matlosana, Dr KK District, NW and National Total, 2007-2017

(Source: IHS Markit Regional Explorer Cited by Matlosana IDP, 2022/23)

The mining industry's yearly growth rate plummeted from 1996 to 2001, falling by 15%, while employment in the Klerksdorp region fell by 44% over that same period. There were just five active shafts out of a historic 28 in 2024, a further 27% decline in employment in the mining sector (South African Cities Network, 2024). As employment prospects diminished, households had financial difficulties, hence intensifying challenges related to poverty, inequality, and societal turmoil. The infrastructure that was initially established to facilitate mining activities saw a decline, resulting in a strain on various public services due to the lack of mining-generated earnings (Makgetla *et al*., 2019).

Nevertheless, despite their significant challenges, the socioeconomic effects were only one facet of the larger mining conundrum. Unrepaired mines pose major environmental risks. Large-scale mining operations have caused major surface disturbances over many decades, which has led to the build-up of residues containing a variety of compounds, some of which have been found to pose serious toxicity risks. Soil degradation and groundwater pollution have become major concerns, with repercussions for agriculture, natural ecosystems, and human health (Laker, 2023). As highlighted in Chanda-Kapata's (2020) thorough analysis of mining regions in East and Southern Africa, the public health

consequences were particularly noteworthy, as communities experienced a rise in the incidence of diseases linked to mining pollution.

Furthermore, the challenges posed by inactive gold tailings storage facilities made the environmental and health issues worse. These outdated facilities pose chemical and physical risks. Nwaila's (2021) examination of Davidsonville in the Central Rand region found that these storage locations cause community problems, legal issues, and health issues.

Poor structural and legal frameworks exacerbated mine closure and rehabilitation. Several mining firms failed to restore and rehabilitate post-mining environments. The limitations, which Kuipa (2023) and De Koker (2020) have extensively examined, demonstrate the need for a comprehensive and robust mine closing framework.

Note that the discussion about gold mining communities, particularly in South Africa, offers new perspectives on the SDGs. Cole and Broadhurst (2021) say that many of the Sustainable Development Goals (SDGs) are met in the mining villages of West Wits Goldfield. The environment, public health, economic growth, and social fairness are some of these goals. The way the group is going about things shows how hard it is to reach these goals in political, economic, and environmental settings.

Klerksdorp shows that mining has complex effects. Mining boosted the economy. These mines' closures and unrehabilitated sites have caused various issues. Environmental protection, socio-economic revitalisation, public health, and community involvement are needed to address these concerns. Klerksdorp's complex experiences are the focus of this study. It aims to provide findings that could affect future initiatives in mining towns worldwide.

From the late 19th century gold discovery, the Matlosana area—more especially, Klerksdorp—has been central in South Africa's mining story. Gold's discovery set off a fast flood of labour and money that turned the area into one of the throbbing arteries of South Africa's economic engine (South African Cities Network, 2022). But this period of wealth set the stage from the beginning on the erratic cycles of world commodities markets and limited mineral reserves. The natural boom-and-bust character of the mining sector meant that, even if the area might see times of great economic activity, these would inevitably be followed by downturns once the ore veins were depleted or world demand changed (South African Cities Network, 2015).

The Klerksdorp story is as much about human effort and social change as it is about industrial activity. The reliance of the economy on mining has been both a blessing and a curse; it has driven many developments, bringing better infrastructure, more employment, and social mobility while simultaneously entrenching economic inequalities and environmental neglect. The striking variations in post-mining communities, where once-thriving towns struggle with reduced economic possibilities and declining public services, highlight the shifting socio-economic fabric (Makgetla *et al*., 2019). Acid mine drainage, ground subsidence, and hazardous waste heaps are continual reminders of mining prosperity's failed expectations, and their cumulative impact is especially stunning (Laker, 2023).

Historically, the need to maximise South Africa's rich mineral resources has eclipsed issues of sustainable practices and long-term foresight in mine closures and land rehabilitation programs (Laker, 2023). At the height of mining activity, corporate objectives were primarily focused on boosting short-term profits, typically at the expense of careful socioeconomic responsibility. This was largely made possible by a regulatory framework that was either infantile or weak, unable to enforce stringent environmental safeguards or require mining firms to make restorative promises (Kuipa, 2023). The minimal focus on sustainable mining techniques has left a negative legacy shown by the continuing existence of unrehabilitated mines. By exposing nearby agriculture to pollutants and land degradation, these abandoned sites still pose major risks to the integrity of regional ecosystems as well as to the surrounding populations (Kuipa, 2023). Modern legislation like the Mineral and Petroleum Resources Development Act strengthens limits and rehabilitation procedures to correct past mistakes, but their application is inconsistent. Bureaucratic inefficiency and financial constraints hinder monitoring and enforcement, worsening inconsistency and neglecting numerous areas (De Koker, 2020).

Matlosana needs a balanced economic plan due to mining's cyclical economic benefits and environmental drawbacks. Mining's dominance created an economic monoculture vulnerable to commodity price changes (Makgetla et al., 2019). Klerksdorp must rethink its economy once mining activity declines, leaving abandoned mines and signs of a lively past. The emphasis should turn to building resilience and sustainability by using the latent possibilities of its human resources as well as natural ones. If properly managed, the legacy of mining can be a strong catalyst for socio-economic revitalisation and ecological restoration, turning the area into a shining example of transformative change instead of letting it lie as a monument of environmental neglect and economic hopelessness (Cole &

Broadhurst, 2021). Such transforming initiatives will call for coordinated action among local communities, corporate sector players, and government agencies to promote an inclusive and sustainable economic renewal.

Moreover, the socio-political environment of the apartheid era greatly affected mining activities and the nature of the closure of mines. Policy and practice occasionally prioritised fast resource exploitation over ethics and population well-being during that time. Focusing on resource outputs sometimes ignored the collateral harm caused to the environment and local inhabitants, who suffered most from pollution and land acquisition without fair distribution of wealth (Chanda-Kapata, 2020). These past injustices have exacerbated land restitution, community empowerment, and mining wealth-sharing difficulties. Mine rehabilitation plans must address environmental, economic, historical, and social justice due to these deep-rooted challenges. This comprehensive approach promotes a sustainable and fair future for communities and remedies past injustices (Chanda-Kapata, 2020).

The rich but brutal history of South Africa's mining sector permeates this piece, and Matlosana is a microcosm of national and worldwide mine closure and socio-environmental issues. This foundation is needed to solve mining communities' complex challenges and achieve sustainable and fair growth (Cole & Broadhurst, 2022). This work explores these deep dynamics and contributes to information that helps solve problems long-term.

1.3 Definition of terms

To understand the intricacies of mine closure and unrehabilitated mines, specific terminologies must be defined. For clarity, this section explains these concepts:

a) **Mine Closure:** The end of mining operations in a certain location. A closure involves either a temporary shutdown or a permanent cessation of all operations. The process includes decommissioning, reclamation, and post-closure maintenance (Sibanda, 2021).

b) **Unrehabilitated Mines:** These are mining sites where operations have ceased, but no effective measures have been implemented to restore the land to a usable condition. Such sites often have lingering environmental, social, and health impacts (Kuipa, 2023).

c) **Host Communities:** Refers to the local population and settlements that exist in proximity to mining operations. These communities often bear the immediate socio-economic and environmental impacts of mining activities (Cole & Broadhurst, 2020).

d) **Gold Tailings Storage Facilities:** Areas where the by-products (tailings) of gold mining are stored. These often contain residues of harmful chemicals used in the extraction process (Nwaila, 2021).

e) **Sustainable Development Goals (SDGs):** A set of 17 global goals set by the United Nations in 2015 to address various global challenges, including poverty, inequality, environmental degradation, and peace (Cole & Broadhurst, 2021).

1.4 Problem Statement

As of 2024, only five out of 28 historical mines (about 18%) remain active in Matlosana, North West Province, South Africa (DMRE, 2024). The closure of mines and lack of rehabilitation have caused significant environmental degradation and socio-economic disruption. Communities face unemployment, water pollution, soil contamination, and rising respiratory and waterborne diseases (Chanda-Kapata, 2020; Laker, 2023). Stilfontein Mine's closure alone led to 24,000 job losses, severely affecting livelihoods (Marais et al., 2024). Although legislation like the Minerals Act (1991) mandates Environmental Management Programmes (EMPs), enforcement remains weak, especially in dolomitic zones like Klerksdorp (Kuipa, 2023). Localised policies are lacking, and governance gaps worsen the problem (Marais et al., 2022; Simatele, 2022). Fragmented post-mining planning leaves communities without long-term economic alternatives or health safeguards (Makgetla et al., 2019; Cole & Broadhurst, 2020). Regulatory inconsistency further deepens poverty and ecological damage (Swart, 2021; Chigumira & Ndlela, 2020). This study aims to assess these intersecting challenges and propose targeted policy responses for sustainable post-mining recovery in Matlosana.

1.5 Research Objectives

The study's objectives were established as follows:

1.5.1 Primary Objective

To investigate the immediate and long-term environmental impacts of mine closures and unrehabilitated mines in the Klerksdorp region.

1.5.2 Secondary Objectives

To support the primary objective, the study will:

a) Examine the socio-economic repercussions experienced by host communities following mine closures.

b) • Evaluate the efforts and adequacy of rehabilitation measures initiated by mining companies.

c) • Assess the effectiveness of the South African legislative and regulatory framework governing mine closure and rehabilitation.

d) Explore the alignment of mining practices with Sustainable Development Goals (SDGs), particularly those related to environment, health, and economic development.

e) Investigate the degree to which Integrated Development Plans (IDPs) and Social and Labour Plans (SLPs) are harmonised in post-mining community recovery.

1.6 Research Questions

To address the objectives outlined above, the study will answer the following questions:

a) What are the immediate and long-term environmental hazards linked to unrehabilitated mines in Klerksdorp?

b) How have mine closures impacted employment, local economies, and household well-being in host communities?

c) What rehabilitation strategies have mining companies implemented, and how effective and sustainable are these measures?

d) How effective is the current policy and legislative framework in ensuring responsible mine closure and environmental restoration?

e) To what extent do mining activities and post-closure outcomes align with relevant Sustainable Development Goals (SDGs)?

f) How well integrated are municipal IDPs and mining Social and Labour Plans (SLPs) in addressing community development post-mining?

1.7 Scope of the study/Delimitations

1.7.1 Field of study

The study predominantly revolves around corporate governance, focusing on the environmental, social, and governance (ESG) goals. ESG goals are the non-financial metrics that a company uses to assess their governance standards, social responsibility, and environmental influence.

1.7.2 Sector under Investigation

The mining sector, specifically the gold mining industry, is the focal point of this study. The emphasis will be on mining corporations, their operational practices, post-operational responsibilities, and the associated corporate social responsibilities.

1.7.3 Geographical Demarcation

The townships in and around Klerksdorp, Orkney, Stilfontein, and Hartebeesfontein are all included in the study's geographic scope, which is restricted to the City of Matlosana's municipal boundaries.

The study will be limited to Harmony Gold, Village Main Reef, and China African Precious Metals, the three current prominent mines in the region; this will include the historical role of AngloGold Ashanti, which was the initial owner of those mines before selling them. As a result, it will not include the area's inactive gold mines, Hartebeesfontein and Buffelsfontein Gold Mines. The local government, Economic Development Consultants, the Department of Mineral Resources and Energy (DMRE), and community forums are among the other parties that will be involved in the research.

1.8 Significance of the study

This study is significant since of its multifarious approach to handling the difficult problems related to mine closures and their effects on communities like those in the Matlosana area. Given South Africa's historical and continuing dependence on mining, knowing the effects of mine closures is critical. This study is significant for stakeholders interested in sustainable development and economic diversification in mining-dependent areas (Makgetla et al., 2019). Academically studying the Matlosana people's difficulties advances mining and post-industrial regional development and offers practical advice to help

corporate and government policies achieve more sustainable economic models (Sibanda, 2021).

This study provides evidence-based ideas to remedy policy gaps in mine closure and environmental restoration policies. The report urges tighter enforcement and responsibility to help legislators reform legal frameworks to ensure mining firms meet their social and environmental commitments by highlighting the discrepancies between present regulations and their implementation (2023, Kuipa). The forward-looking approach of connecting mining operations with the Sustainable Development Goals (SDGs) encourages local and international stakeholders to reassess their sustainability efforts (Cole & Broadhurst, 201). Alignments are necessary to meet global norms and facilitate a fair transition for affected populations, ensuring that economic development does not compromise social or environmental justice.

This study gives Matlosana communities a valuable forum to discuss their sometimes overlooked issues and lived experiences about the socioeconomic and environmental repercussions of mine closures. These villages have suffered the most for years from mining without enough means to voice their complaints or influence decision-making procedures (Chanda-Kapata, 2020). By elevating their stories, this study not only increases their voices but also helps to better grasp the several difficulties they encounter following mine closures. Equipped with empirical data and insights from this study, community members can better advocate for their rights and demand increased responsibility from both mining corporations and government entities. Furthermore, this empowerment is essential for building community resilience so that they may actively participate in determining post-mining futures and investigating alternative economic activities that might sustain long-term development in the absence of conventional mining operations (Cole & Broadhurst, 2020). Therefore, the study helps to strengthen efforts at community capacity-building by laying the foundation for sustainable livelihood prospects that support social well-being and economic vitality.

Furthermore, the relevance of the study reaches both scholarly research and business operations. Specifically, regarding mine closure planning and site rehabilitation, the study provides actionable insights for industry practitioners on the essential integration of robust environmental and social governance principles into their operational frameworks. Understanding the wider consequences of their activities outside of just financial benefit will help mining companies create more environmentally friendly and responsible plans that reduce damage and improve community welfare. In a more environmentally sensitive

world, this move reduces regulatory non-compliance and community resistance risks and may improve business reputations and stakeholder relations.

Academic scholars advance knowledge by finding innovative approaches to help mining-affected communities shift sustainably. The findings suggest that environmental science, socioeconomic development, and public policy should be linked to find multidisciplinary solutions to mining's residual consequences (Cole & Broadhurst, 2021). This study emphasises methodological rigour and provides thorough empirical assessments to the scholarly debate. It intends to encourage academic research into the complex processes of post-mining rehabilitation and community resilience, expanding existing knowledge. This sets up a study plan to find environmentally friendly ways to get to Matlosana and other mining areas. This helps us learn more about how societies can change their economies from relying on extractive industries to ones that are more diverse and long-lasting.

Finally, the study's ability to impact several vital areas makes it relevant. The study fills knowledge gaps to illuminate long-ignored socio-economic and environmental issues facing mining communities. This exploration of complex reality helps academics, industry leaders, and governments make informed and smart decisions. The report also provides empirical data to inform legislative discussions on the need for stricter mining regulations and more effective regulatory structures. The study's practical findings and policy reform alignment will determine how well these goals are met. Such reforms aim to ensure that industrial practices match environmental and social responsibility, reflecting a balanced approach to economic development.

Another pillar of the influence of the study is the advocacy of mining industry sustainable practices. The study motivates the mining sector to use models that give environmental rehabilitation and community involvement top priority by stressing best practices and effective case studies. This drive towards sustainability promises to be very helpful for the long-term development path of mining areas since it protects them from future environmental damage and improves the quality of life for present and next generations. Thus, the study seeks to protect the impacted areas' ecological integrity and promote sustainable economic utilisation. It protects and enhances these legacies without forgetting historical injustices or socioeconomic disparities. In the end, the study hopes to inspire a whole approach whereby social equity and environmental preservation coexist hand in hand with economic development, so building strong and vibrant communities.

1.9 RESEARCH METHODOLOGY

1.9.1 Literature Study

The literature study for this research will focus on existing studies and reports examining the implications of mine closures and unrehabilitated mines on surrounding communities. Socio-economic and environmental implications, especially in South African mining, will be prioritized. To fully grasp the topic, scholarly articles, government reports, company records, and industry case studies will be reviewed. EbscoHost, Google Scholar, and government archives will be used to analyze mine closure, rehabilitation, and community resilience frameworks.

Studies have shown that sustainable mine closing procedures have major limitations. Nene (2019) examined South African mine rehabilitation financial security measures and found that poor implementation worsens community issues. Cornelissen et al. (2019) examined abandoned mine rehabilitation, while Marais et al. (2024) linked worldwide mine closures to local socio-economic repercussions. Despite these contributions, specific study on Klerksdorp communities' unique difficulties is lacking. Addressing this gap will make the findings more contextual and offer policy change recommendations.

1.9.2 Empirical Investigation Instruments

A qualitative research method is used in this study, and semi-structured conversations are the main way that data is gathered. The purpose of these interviews is to get in-depth accounts of what people have experienced, thought, and felt about the effects of mine closures and mines that have not been fixed up. The main topics will be things like damage to the environment, health risks, economic upheaval, and keeping society together. Iteratively, interview questions will be made and tested with a small group of participants to make sure they are clear, relevant, and in line with the study goals.

A lot of research has shown that qualitative methods are good for looking into complicated human situations. As Campbell et al. (2020) pointed out, it is very important to be ethical when recruiting participants and gathering data. They pushed for informed permission and privacy. Kumar (2019) also talked about the best ways to set up semi-structured interviews, such as using a mix of open-ended and organized questions to get a lot of different kinds of information. By following these guidelines, the study makes sure that the data it gathers is solid, reliable, and true to the lives of people who live in Klerksdorp.

1.9.3 Research Population and Sample

The research population is Klerksdorp residents affected by mine closures and unrehabilitated mining. Former mining workers, community leaders, and residents affected by socioeconomic or environmental issues are included. Accessibility and diversity will be prioritized when recruiting participants via convenience sampling. This method allows people with different mining exposures to participate.

According to Mweshi and Sakyi (2020), convenience sampling works well for exploratory investigations in geographically defined groups. Zickar and Keith (2023) stressed the need of adjusting sampling procedures to the research setting to ensure participants contribute valuable insights into the phenomena under study. This study maximizes comprehension of the Klerksdorp context by sampling people who have firsthand experience with mining consequences.

1.9.4 Data Analysis

Thematic analysis, which can be done with tools like Atlas.ti, will be used to look at the data collected for the study. Coding interview transcripts is one way to find recurring themes and trends in the effects of abandoned mines on society, the economy, and the environment. Researchers can get to the bottom of complicated problems with the help of thematic analysis, which works best for exploratory studies. Word clouds and other visual aids will also be used to draw attention to words that are used a lot, which will help find the main themes.

There is a lot of evidence that thematic analysis works well in qualitative study. Silverman (2016) said that this method makes it possible to organize data in a way that supports the main goals of the study. In the same way, Laker (2023) talked about how visualization tools like word clouds can help with data interpretation and make abstract results easier to understand. By using these different types of analysis, the study makes sure that all the data is fully understood. This will help the researchers come up with useful suggestions for how Klerksdorp towns can deal with the problems they are facing.

1.9.5 Empirical Study

Our empirical research comprises interviewing 12–15 Klerksdorp residents. These participants will come from diverse backgrounds to get different insights on mine closures. The interviews aim to reveal the environmental, economic, and social effects of

unrehabilitated mines to provide policy suggestions. These interviews' data will be evaluated to uncover themes and trends to meet study goals.

Community-level impact studies have consistently stressed stakeholder engagement. Cole et al. (2024) provided a framework for examining post-closure potential, stressing inclusive research methods. McCusker and Gunaydin (2015) have noted that qualitative methods can capture the complexity of mining-affected human experiences. This study uses best practices to guarantee its findings are trustworthy and relevant to Klerksdorp's needs.

1.10 Layout of the Study

The study is organized logically into five parts, and each one helps the reader fully grasp the research topic and what it means:

Chapter 1: Scope and the Nature of the Study

This chapter introduces the research's backdrop, problem statement, aims, and questions. It introduces the study's relevance, scope, and limitations, as well as its methodology and report structure.

Chapter 2: Literature Review

This chapter takes a close look at the research that has already been done on mine closures, environmental restoration, and the social and economic effects they have on the towns that surround them. The review puts the study into relevant theoretical frameworks and points out knowledge gaps. It stresses the global significance of the Sustainable Development Goals (SDGs) and how they relate to sustainable mining practices.

Chapter 3: Empirical Investigation

This chapter focuses on the research methodology and design, providing a detailed explanation of the qualitative methods employed, such as semi-structured interviews and focus groups. It elaborates on the data collection and analysis processes, ensuring methodological rigor and reliability in addressing the study’s objectives.

Chapter 4: Data Analysis and Discussion

This chapter integrates empirical and literature review findings. Thematic analysis shows patterns, trends, and complexities in Klerksdorp communities' impacts from mine closures

and unrehabilitated mines. The discussion critically assesses these findings in light of the study's goals and theoretical and practical contexts.

Chapter 5: Conclusions and Recommendations

Key study findings are synthesised in the final chapter to address research aims and questions. It advises governments, industry stakeholders, and community leaders on how to mitigate mine closure impacts and promote sustainable development. The chapter also suggests future study to advance this field.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A vital part of academic research, the literature review provides a basis for fresh investigations built on synthesising current knowledge and pointing up gaps the present study aims to solve. Within the framework of mine closures and their effects on South African communities, a thorough review of the literature offers understanding of the several difficulties these closures present as well as possible routes to sustainable solutions (Flick, 2015). This review seeks to combine several strands of current research covering socio-economic, environmental, and regulatory effects, thus producing a complex knowledge of the involved issues. Through methodically reviewing the corpus of work already clarifying several aspects of mine closures, the study positions itself to contribute especially to academic discourse and guide important policy and practice (Kumar, 2019).

Historically, the academic and policy debate over mine closures has mostly focused on the immediate financial effects, especially job losses and the consequent drop in local businesses. Recent research, however, has broadened the discussion to include environmental and socioeconomic issues as well (Mogotsi & Kok, 2022). Makgetla et al. (2019) have highlighted the knock-on effects of mine closures beyond simple job loss, showing their impact on community cohesion and household vulnerability. They argue that without deliberate planning, such closures can deepen structural inequality. Maseko and Gumede (2021) add that affected communities often experience long-term social fragmentation, requiring robust policies for resilience and economic diversification.

The environmental literature highlights substantial concerns with unrehabilitated mining site management. According to Laker (2023), abandoned sites can become "hotspots" of environmental degradation when heavy metals leach into nearby soil and water systems, jeopardising human and ecological health. Industrial activity exacerbates these effects through cumulative toxic waste exposure. Post-mining environments require ecological restoration; hence, Mhlongo (2023) and Nwaila (2021) stress the need for targeted, science-based rehabilitation frameworks. There is growing consensus that interdisciplinary approaches integrating environmental science, public health, and development economics are vital to sustainable land-use transitions (Wright et al., 2020).

The literature also emphasises the challenges within South Africa's legislative framework governing mine closures. Swart (2003) outlines how the Mineral and Petroleum Resources Development Act (MPRDA) was designed to link mining with sustainable development

through Environmental Management Plans (EMPs). However, Van Druten and Bekker (2017) argue that enforcement is undermined by weak institutional capacity and poor interdepartmental coordination. This critique is echoed by Phalatse and Mtembu (2022), who note that regulatory fragmentation delays rehabilitation implementation and discourages compliance. Mpanza et al. (2021) call for reform measures that emphasise accountability, transparency, and enforceability to protect host communities.

Finally, scholars have increasingly examined mine closures in light of the Sustainable Development Goals (SDGs). Dzimiri (2024) emphasises the disconnect between mining operations and global sustainability objectives, especially those related to environmental protection (SDG 13), decent work (SDG 8), and clean water (SDG 6). Rather than seeing closure as a failure, Measham et al. (2024) suggest viewing it as an opportunity for socio-ecological regeneration, provided closure planning is inclusive and forward-looking. Their perspective shifts mine closures from being end-points to transformation catalysts. Integrating these perspectives helps position this study within broader developmental imperatives and offers a framework for evaluating policy coherence, regulatory efficacy, and community resilience in post-mining contexts.

2.2 South African Mining Sector Overview

Historically and in modern times, the mining industry of South Africa is a pillar of the national economy, supporting industrialisation and socioeconomic growth of the nation. At its height, the mining sector made South Africa among the top global producers of gold, diamonds, platinum, and other minerals. The discovery of gold on the Witwatersrand in 1886 triggered a mining boom that reshaped the economic landscape and catalysed urban development, establishing mining as the engine of South Africa's early industrial economy (Marais et al., 2012). Today, the sector continues to contribute significantly to GDP, foreign exchange earnings, and employment, although its share has gradually declined due to structural changes and resource depletion (Dixon, 2003; Statistics South Africa, 2015).

The contributions made by the mining industry go beyond economic metrics; the sector has deeply influenced labour relations and the sociopolitical structure of the country. Historically, mining operations operated within racially stratified systems that exploited cheap Black labour under hazardous conditions, embedding inequality and poor social outcomes (South African Cities Network, 2015). Although post-apartheid reforms introduced social licensing and corporate social responsibility mechanisms, the legacy of marginalisation persists. Today's mining activities are increasingly scrutinised for their

commitment to fair labour practices, inclusive development, and ethical resource governance (Moloi & Mokoena, 2021). Sibanda (2021) further stresses that current community expectations demand not only employment but also long-term socio-economic investments from mining companies.

Moreover, the industry's long-standing environmental liabilities—such as land degradation, acid mine drainage, and deforestation—remain contentious. These effects prompted the introduction of the MPRDA and associated environmental laws aiming to harmonise resource extraction with ecological protection (Swart, 2003). However, enforcement remains inconsistent due to underfunding and institutional gaps (Van Druten & Bekker, 2017). Mutuso and Kanyane (2023) argue that environmental compliance is often reduced to a box-ticking exercise, particularly when companies are approaching closure. This undermines rehabilitation efforts and leaves municipalities with unrehabilitated sites and social discontent.

Amid these pressures, the South African mining sector faces mounting global and local demands to reimagine its developmental role. Mineral dependence exposes the economy to commodity price volatility, thus highlighting the need for diversification and structural transformation (Makgetla et al., 2019). Local communities increasingly demand equitable benefit-sharing, participatory governance, and post-mining economic opportunities (Chigumira & Ndaguba, 2022). Maseko et al. (2023) suggest that innovation in sustainable technologies, inclusive planning, and stronger local-government collaboration are pivotal to repositioning the sector within the framework of just transitions.

The complexities of the South African mining sector—rooted in historical injustice, economic dependency, and fragmented governance—frame the context within which the Matlosana case must be analysed. Effective adaptation to the twin pressures of sustainability and social justice requires a recalibration of policy, practice, and political will. This review therefore lays a foundation for evaluating how mine closures in Matlosana reflect broader systemic dynamics and how they might contribute to shaping a new, equitable post-extractive development path.

2.3 Conceptual Framework

This study examines the social, environmental, and legal elements of mine closures and restoration using a multidimensional conceptual framework to ensure sustainable development. Mining transitions present socio-economic, ecological, and governance concerns that the framework addresses using diverse ideas and methods. Integrating

these dimensions helps explain the complex relationship between mine closures and community resilience, especially in Klerksdorp.

2.3.1 The Concept of Mine Closure

Mine closure is the structured process of transitioning a mine from active operation to a non-operational state in a manner that minimises risks to human health and the environment (Mutuso & Kanyane, 2023). True mine closure extends beyond ceasing operations—it requires comprehensive rehabilitation of the environment, decommissioning of infrastructure, and development of socio-economic strategies to support communities affected by the loss of mining activity. Nene (2019) highlights the inconsistencies in legal compliance in South Africa, noting that closure protocols are often ignored, leaving environmental liabilities and socio-economic fallout. Similarly, Odoh et al. (2022) stress that the failure to implement robust closure planning results in heightened vulnerability for mining-reliant regions, especially in cases where enforcement capacity is weak.

In Klerksdorp, extensive historical mining activity has left behind over 200 unrehabilitated pits, posing threats to both ecological systems and public safety (DMRE, 2022). Laker (2023) notes that the lack of timely and accountable rehabilitation has created dangerous voids in both environmental stewardship and public infrastructure. One of the key issues is the uncertainty surrounding responsibility, particularly when mining licenses change hands frequently or are held by shell entities (Nyathi & Phiri, 2021). This legal ambiguity delays remediation and prolongs community exposure to hazards. Mentis (2020) calls for stronger implementation of current laws, while de Oliveira & Macuacua (2023) propose collaborative governance approaches that involve municipalities, traditional leadership, and mining firms in closure planning. These perspectives suggest that closure requires not only legal rigour but also inclusive coordination frameworks and equitable distribution of responsibilities.

2.4 Mine Closure Socio-Economic Effects

Mine closures affect the economic, labour, and social structures of mining towns such as Matlosana. Small businesses and informal economies closely tied to mining operations are especially vulnerable (Ngxongo & Dlamini, 2021). Job losses resulting from resource exhaustion or cost-driven shutdowns have ripple effects on dependent local enterprises, leading to regional economic contraction. Sibanda (2021) emphasises that the volatility of mining-dependent economies makes them susceptible to external shocks such as commodity price fluctuations, which exacerbate closure-induced downturns.

The literature further shows that unplanned or poorly managed closures contribute to rising unemployment, widening inequality, and social instability. Communities experience a breakdown in social cohesion, rising poverty, and increasing reliance on overstretched welfare systems (Nyamnjoh & Ndaba, 2022). These dynamics often result in higher crime rates, increased youth disenfranchisement, and deteriorating trust in local governance structures. Beyond immediate economic hardship, the psychological impacts of sudden deindustrialisation—such as anxiety, family dislocation, and loss of identity—are frequently underestimated (Dzimiri, 2024). These outcomes are particularly severe in regions where mining has historically provided not just jobs, but a sense of place and purpose.

The challenge of economic diversification is amplified in such post-mining environments. Affected communities often lack the infrastructure, training, and institutional support required to transition into other sectors. The absence of targeted retraining or small enterprise development hinders recovery, leaving local economies stagnant (Mutambara & Mawowa, 2021). While Kuipa (2023) attributes this to policy neglect, other scholars argue for the strategic deployment of inclusive development incentives, including tax breaks for SMEs, vocational hubs, and investment in green economy sectors (Matebesi & Nel, 2024; Chisadza et al., 2022).

Policy reform is thus vital. Edwards and Maritz (2019) advocate for anticipatory economic transition planning, led jointly by mining corporations, government departments, and municipal authorities. These strategies should begin prior to closure announcements and incorporate scenario planning, workforce mapping, and infrastructure audits. Mqotyana (2022) argues that community participation is essential—not just for legitimacy, but to ensure that post-mining development pathways are contextually relevant and locally owned. Public-private-community partnerships (PPCPs) could be instrumental in aligning rehabilitation efforts with local needs and employment generation.

Overall, the socio-economic consequences of mine closure in Matlosana illuminate the intersections between historical economic dependence, identity, and resilience. Long-term solutions require comprehensive strategies that combine state policy, private sector accountability, and grassroots innovation. Mine closure should no longer be viewed merely as a technical event but as a pivotal transition moment demanding inclusive development planning and sustained investment in community regeneration.

2.5 Environmental Impacts and Rehabilitation Challenges

Mine closures generate significant environmental burdens due to their prolonged impact on ecosystems, land surfaces, and water systems. Abandoned and unrehabilitated mine sites are known to emit harmful pollutants into air, soil, and groundwater, often in the form of acid mine drainage, toxic metals, and particulate dust (Laker, 2023; Mhlongo, 2023). Tailings, particularly from gold mining, frequently leach arsenic, cyanide, and heavy metals into aquifers, thereby threatening agricultural productivity and public health (Nwaila, 2020). As Chanda-Kapata (2020) explains, subsistence farming communities located near these sites face heightened vulnerability to food insecurity and disease outbreaks due to environmental degradation.

Although South Africa has developed a relatively comprehensive legal framework for mine rehabilitation—anchored by the Mineral and Petroleum Resources Development Act (MPRDA)—its implementation remains fraught with limitations. Swart (2003) outlines that environmental management plans (EMPs) are legally required at the start and closure phases of mining, but Van Druten and Bekker (2017) find that poor enforcement, resource shortages, and institutional fragmentation hinder compliance. Tsegaye and Chimuka (2021) further argue that weak coordination between regulatory agencies and local authorities often results in poorly executed or entirely abandoned rehabilitation efforts. These gaps in oversight mean that environmental liabilities persist long after economic value has been extracted, posing long-term risks to sustainable land use and ecological recovery.

In response, recent scholarship highlights the value of adaptive management frameworks to address the complexities of environmental rehabilitation. Adaptive management entails continuous feedback loops involving stakeholders—scientists, community members, and engineers—in refining interventions based on ecological monitoring (Van Eeden & Liefferink, 2022). Unlike static environmental plans, this model promotes local agency, iterative learning, and resilience-building. Importantly, it prioritises culturally appropriate strategies that recognise the social-ecological history of the affected landscapes (Odoh et al., 2022). Community-led initiatives are especially effective in areas where traditional ecological knowledge can inform land restoration techniques and improve public ownership of post-mining landscapes.

Despite institutional shortcomings, case studies demonstrate promising innovations in mine rehabilitation. Maseko et al. (2023) document the use of drone-based monitoring, satellite imaging, and bioremediation techniques that accelerate ecological recovery. Pilot

projects in Mpumalanga and the Northern Cape have shown success in stabilising soil, reintroducing indigenous plant species, and improving water retention through bioengineering methods (Dlamini & Sithole, 2021). Such approaches align with global trends in ecological restoration, which increasingly emphasise biodiversity enhancement alongside pollution control. In some instances, post-mining landscapes have been reimagined for eco-tourism, renewable energy installations, or climate-smart agriculture (Measham et al., 2024), offering both environmental and economic benefits.

A coordinated, multi-stakeholder approach is critical for addressing the environmental legacy of mine closures. De Koker (2020) argues that strict compliance with environmental laws must be coupled with innovative ecological engineering solutions and inclusive governance. Partnerships between mining firms, environmental scientists, community leaders, and municipal planners can ensure that rehabilitation efforts are both effective and locally supported. According to Chimuka and Voyi (2022), integrating environmental management into municipal Integrated Development Plans (IDPs) enhances policy coherence and facilitates long-term land-use planning. By addressing rehabilitation holistically—ecologically, socially, and economically—stakeholders can convert environmental risks into development opportunities that serve both ecosystems and affected communities.

2.6 Efforts and Adequacy of Rehabilitation Measures

Mine closure rehabilitation is a social and environmental issue. Rehabilitation of mined land allows commercial usage. The literature shows that ideals rarely match reality. Many mining companies claim to adopt ethical closure policies, but De Koker (2020) finds inconsistent and insufficient execution. This discrepancy is due to corporate accountability, financial restrictions, and insufficient regulation (Mills, 2022).

Financial management is a rehabilitation problem. According to Nene (2019), enterprises must set aside financial security for rehabilitation, but these assets are routinely underestimated and used for other purposes. Former mines could leave large regions unoccupied, increasing environmental harm and limiting land use. Mismanagement of money requires strict supervision and transparency in closing money use and monitoring (Swart, 2003).

The research recommends upgrading technical and methodological rehabilitation processes for success. Innovative technologies that promote biodiversity and ecosystem services should be included in ecological restoration techniques that stabilise landscapes

(Kuipa, 2023). Mentis (2020) suggests local-specific adaptive management methods like scientific soil remediation and ecosystem engineering, and Cole et al. (2024) show how remote sensing for environmental monitoring and advanced bioengineering can improve rehabilitation outcomes.

Rehabilitation programs may disregard community involvement. Local people should help create and implement rehabilitation programs, according to research (Chanda-Kapata, 2020). This considers mining victims' needs and ambitions, teaching responsibility and care for the restored region. Participatory methods improve societal acceptability of rehabilitation projects and critically analyse conventional land management tactics for current restoration projects, according to Marais et al. (2024).

Some successful programs offer growth concepts despite these challenges. Mqotyana (2022) shows how rehabilitation can turn mining sites into agricultural or leisure regions to sustain economic activity. Most results entail strong business commitment, community partnerships, and efficient multi-disciplinary scientific knowledge application (Mentis, 2020; Edwards & Maritz, 2019).

Despite progress in mining site rehabilitation, substantial work remained to achieve these projects. Rehabilitation fit improves with better regulations, funding, methods, and community involvement. Stakeholders can guarantee post-mining environments are ecologically benign and economically viable, supporting regional growth and resilience.

2.7 Legislative Framework for Mine Closure

South African mine closures are largely governed by the Mineral and Petroleum Resources Development Act (MPRDA), which mandates environmental management and closure regulations for mining (Swart, 2003). This legislation guarantees mining operations satisfy economic, environmental, and sustainable development goals. MPRDA enforcement is inconsistent despite its vast scope, emphasising regulatory control and compliance difficulties (Dixon, 2003).

A critical look at the law highlights pros and downsides that affect mine closure. Mining companies must file Environmental Management Plans (EMPs) to reduce environmental damage and restore mine sites under the MPRDA, which makes closure procedures legitimate (Van Druten & Bekker, 2017). The Act also mandates financial certainty for rehabilitation costs, ensuring businesses have enough money for post-closure activities (Nene, 2019). These strict laws promote proactive environmental conservation. The

framework fails to recover monies due to weak enforcement, policy implementation, and financial security system opaqueness (Mills, 2022).

Bureaucratic inefficiency and regulatory authority underfunding exacerbate the legislative intent-to-implementation gap. Mpanza et al. (2021) report that the Department of Mineral Resources and Energy (DMRE), which monitors rehabilitation projects and compliance, struggles to maintain control due to manpower and money shortages. Mines might be closed without environmental regulations due to capacity difficulties. Governance and monitoring may be difficult with multiple land and water management government agencies (Kuipa, 2023).

The law ignores socioeconomic factors and community involvement in the closing plan. The MPRDA prioritises environmental issues, but the legal system fails to address mine closures' wider impacts on local populations (Marais et al., 2024). This lack shows a very important area where social factors must be considered when making policies to promote community change. By allowing inclusive government that includes community views in closure planning, legislation can better handle the socioeconomic effects of mine closure and promote long-term regional development (Mqotyana, 2022).

Even with these problems, the study suggests that laws be changed to make mine closure rules more resilient and easier to implement. To get people to be more responsible, academics like De Koker (2020) suggest harsher fines for not following the rules and open audits by outside groups. Cole et al. (2024) say that clear methods for managing finances will make rehabilitation projects more ready after they close. Measham et al. (2024) say that South Africa could be a leader in sustainable mining if it took the best ideas from other countries and changed its laws to match.

Enforcement and policy integration problems make the South African mine closing law less effective at reducing the environmental damage caused by the sector. Mining-affected areas can recover economically and biologically with better laws and better ways to close down mines that are bad for the environment.

2.8 Alignment with Sustainable Development Goals (SDGs)

Matching mining operations with the Sustainable Development Goals (SDGs) is becoming increasingly critical for ethical and industry sustainability. The UN's global development plan, the SDGs, encourages fair and sustainable development across sectors by combining economic, environmental, and social components (Cole & Broadhurst, 2021).

These objectives are a baseline for mining activities that historically prioritised commercial gain over social or environmental impact.

The SDGs require businesses, including mining, to ensure sustainable consumption and production (Goal 12), inclusive and sustainable economic development (Goal 8), and immediate climate change action (Goal 13). Although the South African mining industry—especially in areas like Matlosana—has made progress towards these goals, significant misalignments still exist. As Makgetla et al. (2019) rightly note, depending too much on fossil fuels and extractive technologies—often without enough environmental protections—compromises the industry's capacity to really match these global goals. This contradiction demands more thorough integration of sustainable practices into all phases of mining activities, including exploration and closure.

Although there have been attempts in recent years to include SDG ideas into corporate strategy, the success of these projects differs greatly among mining companies (Sibanda, 2021). Complete strategies covering SDG values entail methodical attempts to reduce environmental effects, embrace renewable energy sources, and apply strict mine restoration plans returning land to useful use post-closure (Nene, 2019). Reaching these goals calls for a radical change in how mining companies see and carry out their corporate social obligations, away from tokenistic gestures towards real, quantifiable actions that fit the strategic level of the SDGs (Dzimiri, 2024).

Moreover, alignment with SDGs spans social and financial goals in addition to environmental ones. The mining industry's part in promoting decent work and economic growth calls for a dedication to fair labour practices, equitable profit distribution, and local community involvement (Goal 8) (Cole et al., 2024). Mining companies can help local communities create economic resilience beyond mining by supporting education and skill-building (Marais et al., 2024). Businesses must ensure that local populations benefit from resource exploitation and are not disadvantaged by mining under the SDGs' social elements of inclusion and human rights (Chanda-Kapata, 2020).

Similar challenges exist in SDG-aligned policy frameworks and cross-sector cooperation. These sustainable development ideas can inform national and corporate mining strategies by politicians, business leaders, and community stakeholders (Van Druten & Bekker, 2017). Mining operations that integrate SDGs demonstrate how stakeholder participation and shared accountability may advance development (Nwaila, 2021). These projects can help create an SDG-compliant circular economy that reduces waste and reuses resources (Makgetla et al., 2019).

Finally, SDG integration can sustain mining. Integrating these ideas into operational and strategic goals is tough. Complete alignment requires ethical business practices, policy changes, and stakeholder participation. SDG alignment will improve the mining industry's global reputation and help construct resilient and sustainable communities.

2.9 Technological Innovations in Mine Rehabilitations

Technology is making mine recovery faster and better. New tools for managing the environment offer exciting options for restoring land that has been mined. Using remote sensing, GIS, and bioengineering (Measham et al., 2024), mining companies and environmentalists take care of places that have been damaged. This technology lets people collect spatial data to track changes, check on the environment, and help with repair (Mentis, 2020).

Remote sensing allows unique real-time land cover and vegetation dynamics to monitor mining's ecological consequences and hasten mine rehabilitation (Cole et al., 2024). Satellite pictures and drones offer high-resolution surveillance of big mining sites, revealing erosion, sediment movement, and vegetation loss (Nwaila, 2021). This technique records landscape changes over time by collecting data continuously. Such comprehensive datasets help evaluate rehabilitation programs and make smart conservation plan revisions. Remote sensing enables adaptive management approaches to respond to changeable post-mining situations (Dzimiri, 2024) by early stress detection. In these habitats, rainfall, temperature, and other ecological factors can dramatically impact ecosystem recovery; hence, flexible management solutions that can be dynamically altered based on real-time feedback are crucial.

Bioengineering methods are also used to restore degraded mining landscapes by improving soil stability, encouraging re-vegetation, and restoring natural ecosystems. The most promising option is phytoremediation, which exploits plants' natural ability to absorb and collect contaminants from the soil to improve soil quality and sustain biodiversity (Kuipa, 2023). Combining ecological knowledge with technical usage is crucial to phytoremediation's effectiveness (Chanda-Kapata, 2020). Plant species must be selected to suit post-mining conditions. Ecologists and practitioners should locate plant species with phytoremediation and ecological resilience to thrive in changing environments. This confluence of biology and technology is essential for creating ecologically sound restoration programs that restore ecosystem functions and services.

Beyond environmental restoration, technology connects stakeholders and promotes community involvement and project transparency, making rehabilitation more inclusive. Online dashboards and GIS can creatively convey real-time data and progress updates to local governments, regulatory authorities, and investors (Marais et al., 2024). Transparency on these platforms demystifies rehabilitation and allows educated decision-making, building stakeholder trust (Sibanda, 2021). This level of involvement ensures that mining-related sustainable land management discussions are active. These platforms improve communication and collaboration via technology to ensure that all stakeholders are working towards a common vision of ecological and community resilience, aligning restoration activities with sustainability goals. Finally, purposeful technology utilisation can promote sustainable development in mining-affected communities, supporting social equity and environmental conservation.

Technological solutions for mine rehabilitation are making great strides, but their adoption is still unequal, revealing significant variations in access and capacity across stakeholders. This unequal adoption hurts small enterprises and community organisations, who have limited financial resources and technological competence (Mills, 2022). These organisations must overcome significant obstacles to incorporate modern technologies into their rehabilitation projects due to the high cost of remote sensing equipment, GIS software, and bioengineering techniques. Most of the information needed to employ these technologies is held by larger, wealthier corporations, leaving smaller players behind. Lack of educational and infrastructure support in many regions, especially mining-dependent ones, exacerbates this technological mismatch (Mpanza et al., 2021).

Multimodal investments in mine rehabilitation technology education, training, and infrastructure can close these gaps. First, environmental and technical training from educational institutions can enable future professionals maximise environmental management innovations (Chanda-Kapata, 2020). Practitioner and community training may emphasize local technology use (Marais et al., 2024). These initiatives can benefit from technology companies' resources, mentorship, and experience with technology implementations.

Technology-promoting infrastructure is also crucial. Digital connectivity in mining-affected areas will provide online resources, training courses, and collaborative platforms for learning and adaptation (Sibanda, 2021). Community technology hubs or centres can allow stakeholders test and adopt cutting-edge technologies without hefty ownership costs. Government programs must help smaller businesses and communities overcome financial

challenges to ensure fair technology access. Low-interest loans, grants, and subsidies can fund technical tool purchases and continued instruction (Cole et al., 2024). Encouraging stakeholder knowledge-sharing and cooperation will expand technological knowledge and assist innovative solutions to varied difficulties faced by different places and communities.

Stakeholders may leverage rehabilitation technology breakthroughs by tackling these systematic difficulties and proactively investing in sector-wide technical capacities. This holistic method boosts post-mining environmental management and rehabilitation's economic and ecological feasibility (Mills, 2022). The mining sector can improve community resilience and environmental health by sharing technical advances with all stakeholders.

Technology can improve mine rehabilitation, ecological restoration, and stakeholder involvement. This could address accessibility and capacity-building issues. As the mining sector becomes more sustainable, strategic technological integration will be necessary for fair and successful rehabilitation that benefits the environment and society (Van Druten & Bekker, 2017).

2.10 Trends in Mine Closure and Rehabilitation Going Forward

Global trends in mine closure and rehabilitation increasingly emphasize sustainable development, integrating social, environmental, and economic considerations. Australia and Canada are leaders in establishing robust frameworks that mandate financial provisioning for mine rehabilitation before operations commence, ensuring that post-closure processes are effectively managed. Mills (2022) highlights the successful implementation of financial assurance mechanisms in Queensland and Western Australia, which obligate mining companies to allocate resources for environmental restoration and long-term monitoring. Measham et al. (2024) also say that in order for mine closure frameworks to be viable, they need to include collaborative methods that include all stakeholders at every stage of the process in order to fully address social, economic, and environmental problems. But Nene (2019) criticizes South Africa's method, saying that mine closure rules aren't being followed very well, so abandoned sites aren't being fixed up. This makes social and economic problems worse and damages the environment. For these gaps to be filled, global best practices need to be adopted while being tailored to local governmental and socioeconomic situations.

Improvements in technology have changed the way mines are rehabilitated, making it easier to watch, evaluate, and fix ecosystems that have been damaged. Using tools like

Geographic Information Systems (GIS) and remote sensing together has changed the way we can track damage to the environment and plan how to fix it. Cole et al. (2024) say that these technologies make it possible to precisely pinpoint areas that need to be fixed up, which saves money and time and leads to better results. Using bioengineering methods, which blend biological knowledge with engineering skills, can also help restore ecosystems in new ways. According to Nwaila (2021), these ways have been successful in stopping soil erosion and habitat loss caused by mining. But Mhlongo (2023) says that community participation and incorporating traditional knowledge systems are just as important, even though technology is very important. These parts make sure that restoration projects are good for both the environment and people's cultures. For this reason, community involvement should go hand in hand with the successful use of advanced technologies to make sure that rehabilitation works for the whole person.

Community involvement has become an important part of global plans to close down and fix up mines, as more and more countries see how important it is for everyone to be involved in making decisions. Frameworks like Canada's Towards Sustainable Mining (TSM) program show how important it is to include communities in the planning and carrying out of closure processes. Marais et al. (2024) say that involving the community builds trust, makes things clearer, and makes sure that recovery plans take into account local needs, which leads to better long-term results. Dzimiri (2024) talks about how important social capital is for helping the economy diversify and making sure that communities can bounce back after mines close. But in South Africa, Mpanza et al. (2021) say that community involvement is still low and that people who are affected by problems are often left out of important decision-making processes. This lack of inclusion not only leads to distrust, but it also makes rehabilitation less effective. To get around these problems, we need to improve participatory government models so that all stakeholders, like local communities, are actively involved in making plans for what to do after the closure.

Global standards for closing mines also stress that rehabilitation methods should be in line with larger sustainability models like the Sustainable Development Goals (SDGs). The SDGs give us a big picture way to think about protecting the environment, making sure everyone has the same rights, and boosting the economy in places that used to be mines. Cole and Broadhurst (2021) say that incorporating SDG principles into the process of closing down a mine helps mining companies make smart choices that protect the

environment and boost economic and social growth. For example, projects like reforestation and protecting biodiversity are in line with SDG 15, which is about life on land. On the other hand, SDG 8 is about fair work and economic growth, and projects like creating sustainable livelihoods are in line with that goal. Chanda-Kapata (2020) says that it is especially important to make sure that mine rehabilitation is in line with public health goals in places where mining has caused long-term health problems. Sibanda (2021), on the other hand, warns that this kind of alignment needs a lot of money and cooperation between different sectors, which could be hard for economies that don't have a lot of resources. For this reason, it is very important to come up with custom strategies that take into account both global sustainability standards and local conditions in order to improve mine closure methods.

As mining companies around the world come under more social and environmental scrutiny, it's becoming clearer that they need new ways to close down. Mining sites can now be used for other things, like green energy projects, farming, or tourism, thanks to more progressive rules. This turns liabilities into assets. In their 2024 paper, Measham et al. talk about examples from Australia of how old mines have been turned into solar farms and recreation places, which have created new jobs and helped the environment. Similarly, Marais et al. (2024) say that including adaptive reuse in plans for closure makes communities more resilient and less reliant on mining for long-term economic growth. But Mhlongo (2023) says that reusing old mines should be done carefully, making sure that restoring the environment stays a top priority and that the new uses fit with what the area can and needs. As the world moves toward new and long-lasting solutions, South Africa's mine closure methods need to change to include flexible reuse plans that build on international wins while also dealing with local issues.

2.10 Trends in Mine Closure and Rehabilitation Going Forward

Global mine closure and rehabilitation practices are increasingly shaped by the principles of sustainable development, integrating environmental, social, and economic dimensions. Leading countries such as Australia and Canada have established pre-emptive regulatory frameworks that mandate financial provisioning for rehabilitation before extraction begins. In Queensland and Western Australia, financial assurance mechanisms ensure that mining companies are held responsible for restoration and post-closure land management (Mills, 2022). These frameworks promote long-term accountability and provide a blueprint for integrating closure planning from project inception. In contrast, South Africa continues to struggle with poor legislative enforcement, leaving many sites unrehabilitated and

communities exposed to prolonged environmental and socio-economic risk (Mutuso & Kanyane, 2023). Nene (2019) underscores the legal ambiguities that often hinder closure implementation and recommends adapting international best practices to suit South Africa's governance structures and community realities.

Technological innovation is another transformative trend in mine rehabilitation. Tools such as remote sensing, geospatial mapping, and GIS-based impact assessment have significantly improved how environmental degradation is monitored and addressed. These systems enable the early identification of contaminated zones, enhancing the precision and cost-efficiency of intervention strategies (Dlamini & Sithole, 2021). Bioengineering techniques, including phytoremediation and microbial soil treatment, have shown promising results in restoring degraded ecosystems and addressing erosion (Nwaila, 2021). However, Mhlongo (2023) emphasises that technology alone cannot ensure sustainable outcomes. Rehabilitation must also account for socio-cultural dynamics through community involvement and traditional ecological knowledge. Without local ownership, even the most technically sound interventions may lack legitimacy and long-term impact (Odoh et al., 2022).

Globally, there is a growing emphasis on participatory governance, with community engagement now recognised as a cornerstone of sustainable mine closure. Canada's *Towards Sustainable Mining* (TSM) framework offers a model for embedding transparency, inclusion, and social accountability into closure processes. Similar participatory approaches in Latin America and Scandinavia have demonstrated that community involvement not only improves social trust but also enhances project relevance and resilience (Brereton & Parmenter, 2020). In the South African context, community participation remains uneven. Mpanza et al. (2021) found that local stakeholders are often excluded from formal decision-making, leading to mistrust and resistance. To address this, Dzimiri (2024) advocates for strengthening social capital through inclusive consultation platforms and local governance partnerships that empower communities in closure planning and oversight.

Mine closure strategies are also being redefined through alignment with the Sustainable Development Goals (SDGs). The SDGs offer a global framework for integrating environmental regeneration, economic inclusion, and social justice into mining transitions. For instance, SDG 15 on terrestrial ecosystems and SDG 8 on decent work provide guidance for reforestation efforts and post-mining employment creation (Vermeulen et al., 2022). According to Chanda-Kapata (2020), linking rehabilitation projects with SDG-

aligned public health goals can mitigate the long-term impact of mining on community well-being. Nonetheless, implementation challenges persist, particularly in low- and middle-income countries where resource constraints and fragmented institutional capacity impede comprehensive SDG integration (Sibanda, 2021). A hybrid model that merges global benchmarks with localised, context-specific tools is therefore necessary.

Emerging global discourse also promotes adaptive reuse of closed mining sites as part of broader sustainability transitions. Rather than viewing mine closure as a terminal point, international best practices treat it as an opportunity for regeneration. Projects in Australia have transformed defunct mining areas into solar farms, heritage parks, and recreational hubs, offering new economic pathways while rehabilitating the environment (Pike et al., 2021). In South Africa, similar potentials exist but are yet to be fully exploited. Maseko et al. (2023) highlight pilot projects that incorporate agroecology and eco-tourism into post-mining redevelopment strategies. However, Mhlongo (2023) warns that adaptive reuse must not compromise environmental restoration objectives. Reuse should be carefully planned to reflect local ecological limits, infrastructural readiness, and community priorities.

In sum, global trends point to a shift in mine closure from a compliance-based model to one that is dynamic, participatory, and innovation-driven. For South Africa to align with this trajectory, legal reform, technological modernisation, and social inclusion must be synchronised within a coherent sustainability agenda. Mine closure, when managed holistically, offers a chance to reshape post-extractive landscapes into resilient, just, and ecologically restored communities.

Figure 2.1: Trends in Mine Closure and Rehabilitation

(Source: SAIMM Journal 2021)

2.11 Integrated Development Planning (IDP) and Social and Labour Plans (SLPs)

The intersection between Integrated Development Planning (IDP) and Social and Labour Plans (SLPs) represents a critical avenue for aligning corporate mining responsibilities with municipal development priorities. IDPs are statutory planning instruments used by South African municipalities to guide local socio-economic development, while SLPs are mandated under the Mineral and Petroleum Resources Development Act (MPRDA) to ensure mining contributes to sustainable community development (Dlamini & Reddy, 2022). In theory, the integration of SLPs into IDPs offers a mechanism to harmonise mining company commitments with long-term municipal objectives, particularly in post-closure transitions. However, in practice, this integration remains fragmented and weakly institutionalised.

Studies by Mphambukeli and Nel (2020) show that mining companies often implement SLPs in isolation, without adequate consultation with local governments or communities.

As a result, development projects funded through SLPs are frequently misaligned with local priorities as outlined in municipal IDPs. This disconnect is particularly evident in Matlosana, where several abandoned SLP projects—such as incomplete schools and underused training centres—have been documented following mine closures (Marais et al., 2024). The lack of coordinated planning compromises the long-term sustainability of these initiatives and undermines public trust.

Moreover, there are institutional and legislative weaknesses that obstruct effective IDP-SLP integration. For example, regulatory oversight is divided between the Department of Mineral Resources and Energy (DMRE) and local governments, often leading to poor communication, overlapping mandates, and a lack of joint accountability (Dube & Chigumira, 2021). Municipalities are also frequently under-resourced and lack the capacity to enforce mining compliance with IDP goals. This reinforces a cycle of disengagement in which mining companies pursue compliance for licencing rather than genuine local development impact.

To address this issue, several scholars propose embedding SLP requirements directly into IDP formulation processes through formalised intergovernmental and stakeholder coordination frameworks (Sibanda, 2021; Mqotyana, 2022). This would entail early-stage collaborative planning, shared monitoring systems, and public participation to ensure that mining-linked projects meet local developmental needs. In doing so, IDP-SLP integration could serve as a cornerstone of post-mining resilience by ensuring that social investments are not only legally compliant but also contextually relevant and sustainable.

2.12 Conclusion

According to research, closing a mine comes with a lot of difficult legal, environmental, and social problems that need a lot of planning. Makgetla et al. (2019) and Sibanda (2021) say that socioeconomic effects show how sensitive communities that depend on mining are to changes in the economy. When local businesses close, jobs are lost, which makes poverty, injustice, and social unrest worse. Therefore, to diversify the economy and keep people's jobs, big policy changes and community-led projects are needed (Dzimiri, 2024.02).

Laker (2023) and Nwaila (2021) say that abandoned mines put people and the environment at risk. Enforcement is limited; thus, creative rehabilitation initiatives with community involvement and adaptive management are needed to address environmental

challenges (Mentis, 2020). Rehabilitation efforts are insufficient, according to De Koker (2020) and Kuipa (2023), who recommend methodological changes and financial transparency.

Swart (2003) and Dixon (2003) describe South Africa's mining regulatory framework as a complex combination of robust mechanisms and fundamental faults, especially in the Mineral and Petroleum Resources Development Act. This Act gave the mining industry detailed environmental management requirements to preserve the environment. The MPRDA mandates environmental impact studies, environmental management plans, and rehabilitation for mining companies (Swart, 2003). Despite these stringent conditions, a substantial mismatch between the Act's initial objective and its implementation typically impairs its effectiveness. Due to limited government resources, bureaucratic inefficiencies, and political will to hold strong mining companies accountable (Dixon, 2003), this gap exists. Enforcement is difficult in fragmented government systems since monitoring and compliance are spread among agencies without coordination or supervision. Nene (2019) and Mpanza et al. (2021) advocate for better governance systems that maintain present standards and incorporate socioeconomic issues into closure planning. Environmental health, economic stability, and community well-being should guide mine closures toward sustainable development and human rights.

Cole and Broadhurst (2021) showed that integrating mining activities with the SDGs is optimistic but difficult for sustainability. Global mining sustainability goals include environmental protection, social equality, and economic growth. Mining processes must meet global goals with stronger promises and industry-wide structural transformation (Marais et al., 2024). Mining generally prioritizes short-term economic advantages over sustainability, causing environmental degradation and socioeconomic inequity that hinders SDG development (Chanda-Kapata, 2020). Sustainability must become a sector strategy rather than compliance to meet SDGs. Government, business, civil society, and local communities must have open, inclusive talks to generate new sustainable development ideas for national policies and corporate strategies (Van Druten & Bekker, 2017). Strong cooperation and shared responsibilities enable stakeholders overcome restrictions and grab transformation opportunities, guaranteeing sustainable growth while respecting natural and social boundaries in mining. This inclusive and cooperative approach is needed to embed the SDGs into mining activities and give affected ecosystems and communities a sustainable and fair future.

This literature review summarizes these reasons to explain mine closures' complicated difficulties and mitigation strategies. Measham et al. (2024) found research gaps and the need for multidisciplinary solutions to immediate closure effects, community resilience, and environmental sustainability. This detailed evaluation leads the current research, which analyses Matlosana's history and informs mining area sustainable transition initiatives. This study values lessons learnt and explores creative ways to inspire regulatory frameworks and community activities to increase sustainability, equality, and resilience in post-mining environments.

CHAPTER 3: EMPIRICAL INVESTIGATION

3.1 Introduction

This chapter outlines the methodological framework used to empirically investigate the social and environmental impacts of mine closures in the Matlosana region. The research adopts a constructivist interpretivist paradigm, which acknowledges the subjectivity of human experience and the socio-environmental complexity that characterises post-mining communities. This philosophical orientation allows the study to explore how individuals make sense of mine closures based on their lived experiences, social contexts, and cultural backgrounds (Dang et al., 2024; Tomás & Bidet, 2023).

To ensure analytical depth, the research applies a qualitative approach rooted in methodological rigour. Primary data was collected through semi-structured interviews, focus group discussions, and contextual document analysis, enabling the triangulation of insights across individual, group, and institutional levels (Reyes et al., 2021; Pham, 2024). These methods were selected for their flexibility and their ability to elicit detailed, context-rich narratives reflective of community perceptions, concerns, and coping mechanisms.

Data was examined through thematic analysis, which allowed for the systematic identification and interpretation of recurring patterns and meanings in the qualitative dataset (Naeem et al., 2024; Mannheimer, 2024). The use of ATLAS.ti software enhanced traceability, ensured consistent coding, and supported transparency throughout the analytic process. Ethical considerations were integrated at every stage, including strict adherence to informed consent, confidentiality, and participant well-being, in line with ethical protocols for qualitative research (Tomás & Bidet, 2023; Hossain et al., 2024).

Overall, this chapter presents a structured, adaptable, and ethically sound methodology that supports a comprehensive understanding of how Matlosana communities are navigating the consequences of mine closure. It establishes a foundation for credible, community-informed insights that can inform more just, participatory, and sustainable post-mining governance.

3.2 Research Paradigm

A research paradigm provides the philosophical lens through which the study views reality, constructs knowledge, and applies methodological choices. This study is anchored in the interpretivist paradigm, specifically drawing on social constructivism, which posits that reality is not objectively determined but is instead co-constructed through human interaction and context (Dang et al., 2024; Hossain et al., 2024). In this view, knowledge is

shaped by the meanings that individuals ascribe to their experiences, and multiple, subjective realities are acknowledged.

The ontological position of this paradigm assumes that reality is multiple and constructed through social processes. People interpret the world differently based on their lived histories, cultural backgrounds, and social interactions. The epistemological stance is inductive, meaning that knowledge is generated by closely engaging with participants' perspectives and allowing patterns and themes to emerge from their accounts (Fife & Gossner, 2024; Naeem et al., 2024). This stands in contrast to positivist paradigms, which assume a singular, measurable truth.

Applying this paradigm is especially suitable in examining the effects of mine closures in Klerksdorp, where social, economic, and emotional responses are diverse and complex. The impacts of mine abandonment are not universally experienced but are filtered through community members' roles, histories, and relationships. One individual may frame closure as an economic catastrophe, while another might see it as an opportunity for regeneration, depending on their positionality.

The constructivist lens thus allows this study to capture a mosaic of narratives that reflect the lived realities of residents, former mineworkers, and stakeholders. These diverse accounts form the core of the analysis, enabling a nuanced understanding of how meaning is constructed around mine closures and how communities adapt in the wake of such transformative change (Pham, 2024; Tomás & Bidet, 2023).

The interpretivist paradigm underpins the qualitative methodology employed in this investigation, guiding the researcher to engage empathetically with participants and to interpret their narratives within their specific socio-cultural and environmental contexts. It supports a meaning-oriented and contextually grounded approach to knowledge production, ensuring that the findings reflect the complexities of mine closures and unrehabilitated mining impacts as experienced by the Klerksdorp communities.

Table 3.1: Research Paradigm

Research Paradigm	
Ontology	Interpretivism
Epistemology	Inductive

Source (Own compilation)

3.3 Research Approach

The research approach adopted in this study is qualitative in nature, guided by the interpretivist paradigm to enable an in-depth exploration of participants' lived experiences, perceptions, and contextual realities regarding mine closures and unrehabilitated mining sites in the Klerksdorp area. This approach is appropriate for addressing the study's aim of uncovering the social, economic, and environmental impacts of mining practices as experienced and understood by affected community members and stakeholders.

Inductive reasoning supports exploratory research by allowing insights, themes, and theoretical propositions to emerge from detailed engagement with the data (Naeem et al., 2024; Pham, 2024).

To guide the research design and ensure methodological coherence, the study adopts a structure informed by the "Research Onion" framework, which systematically guides the research process through successive layers — from the overarching philosophical paradigm to the specific strategies and techniques employed for data collection and analysis. This layered framework provides clarity and alignment between the interpretivist worldview, the qualitative methodological choice, and the empirical tools applied in the study. This structure supports a flexible yet systematic design, appropriate for exploring how the closure of mines in Klerksdorp has influenced local livelihoods, community identity, and environmental conditions (Dang et al., 2024). It also accommodates mid-course adaptations in line with new emerging patterns, a hallmark of reflexive qualitative inquiry (Reyes et al., 2021).

In practice, this meant beginning with broad, open-ended inquiry into participant experiences and iteratively refining research focus as themes emerged. This iterative flexibility preserved the authenticity of participants' narratives, ensured responsiveness to contextual nuances, and prevented premature categorisation of their complex realities (Modugno, 2024). The inductive strategy was particularly useful in mapping how mine closures are interpreted differently across stakeholder groups—from former mineworkers to municipal officials—depending on their positionality and exposure to socio-environmental change.

Ultimately, this approach allowed the study to develop context-specific insights grounded in the voices of those most directly impacted. It recognises that meaning-making is dynamic and context-dependent, and thus, the research design had to remain open to new understandings throughout the data collection and analysis process (Fife & Gossner,

2024). This alignment between the inductive method and the study's objectives reinforces the epistemological consistency and methodological integrity of the research.

3.4 Methodological Choice

The qualitative research approach employed in this study is grounded in the principles of social constructionism and methodological rigour. This paradigm facilitates the analysis of the multiple realities constructed through social interactions, particularly as experienced and articulated by those affected by mine closures (Sibanda, 2021). Qualitative methods have proven effective in studies of mining communities, enabling researchers to explore and interpret the intricate social and environmental challenges inherent in such contexts (Cole & Broadhurst, 2020).

In this study, the lived experiences of the Klerksdorp community were explored through semi-structured interviews and thematic analysis, providing a robust framework for identifying recurring patterns and themes. This approach supports the development of evidence-based insights into the challenges faced in post-mining contexts. As Flick (2015) explains, qualitative research distinguishes itself from quantitative models by going beyond mere statistical representation, instead prioritising an understanding of phenomena within their natural settings and emphasising participants' interpretations of their own realities.

The narratives, emotions, and reflections of Klerksdorp residents encompassing their memories of the past, their anxieties about the present, and their hopes for the future cannot be adequately conveyed through numerical data alone. These aspects require depth rather than breadth, capturing the richness of their stories and subjective experiences to inform meaningful conclusions and recommendations.

This decision has several effects:

a) Depth of Data: Qualitative research, by design, delves deep. It is not content with surface-level observations. This process assures that the study collects data and explores its subtleties, paradoxes, and layers.

b) Participant Voice: A qualitative approach provides participants a platform to voice their experiences in their own words. This adds authenticity and grounds the research in Klerksdorp communities' everyday reality.

c) Flexibility: Qualitative research is inherently adaptive. The researcher can pursue developing patterns, topics, or insights during data gathering without rigid structures (Flick, 2015).

3.5 Research Strategy

Having established the methodological backbone, the study's strategy becomes paramount. Using a Klerksdorp case study strategy is intended. Quinlan et al. (2019) note that case studies give depth. Researchers can focus on a scenario, community, or phenomenon and study its complexities.

A case study method for Klerksdorp ensures:

a) **Contextual Relevance**: With its distinct socio-economic and environmental context, Klerksdorp is the focus. This locates the facts and insights locally, making them more relevant and actionable.

b) **Comprehensive Exploration**: A case study approach guarantees that the research does not skim the surface. Every aspect, be it economic, environmental, social, or psychological, will be explored exhaustively, offering a 360-degree view of the impacts of mine closures.

3.6 Study Population and Sampling

According to Banerjee and Chaudhury (2010), a population is the complete target group to whom findings will be applied. To properly identify the population of a research study, the questions, research objectives, and study purpose must all be taken into account (Banerjee, 2010:60). Therefore, it is evident that accurately defining the population is necessary to ascertain which traits qualify participation and which potential participants need to be excluded from the research (Banerjee & Chaudhury, 2010:61).

The planned study intends to use people from the Klerksdorp (KOSH) region's local government authorities, mining houses, community, and business forums. For the researcher to obtain responses from the participants, access to the group is necessary. The researcher will be able to obtain resources from his professional networks as he has experience in the business field.

As there are so many attributes that can be applied to participants, it is essential to ascertain the population sample size. A representative sample size encompasses a certain percentage of the population to decide on the study's inclusion and exclusion criteria (Kadam & Bhalerao, 2010:55). The inclusion and exclusion criteria for this study is described as follows:

Inclusion criteria

- Local Government, City of Matlosana Planning and Development Office

- Active mining houses, Harmony Gold, Village Main Reef and CAPM
- Historical legacy of AngloGold Ashanti

- Department of Mineral Resources and Energy (DMRE)
- Community and Business Forums around Klerksdorp
- Economic Development Consultants around Klerksdorp

Exclusion criteria

- Inactive mining houses, Hartebeesfontein and Buffelsfontein Gold Mines
- Businesses which are not classified as Mines

As previously mentioned, sampling is the process of choosing a population representation from which inferences are to be made (Saunders *et al*., 2019:293). Since collecting data from the entire population would be prohibitive, sampling is done instead. To evaluate data and make better use of resources like money, researchers contend that sampling from a population is far more practical (Turner, 2020:2). Guest *et al*., 2020: 1) examined the idea of data saturation, which is defined as the moment at which the collection of additional data yields no new information that would enable researchers to learn more about their study questions. It poses the question of whether an infinite amount of data helps to address a study's goals.

Data saturation proponents contend that to maximise data saturation, researchers should adhere to three fundamental constructs: base size, run length, and new information threshold (Guest *et al*., 2020:5). Information saturation, according to the researcher, will yield a more accurate data set to meet the goals of the study. Using a strategy known as "*data saturation*," researchers gather qualitative data until the findings point to new themes or information (Saunders *et al*., 2012:283). One-on-one interviews with various stakeholders as mentioned in the inclusion criteria above will be used to get the data. The researcher will interview ten to fifteen people until saturation and information power are achieved.

The sampling approach chosen is purposeful, a technique wherein participants are selected based on specific criteria or characteristics that make their contributions particularly valuable to the research (Silverman, 2016). This ensures that the collected data is rich, relevant, and aligned with the research objectives.

According to Mashwi and Sakyi (2020:180), sampling is a process by which a researcher selects a predetermined number of participants from a broader population using both probability and non-probability methods. Non-probability sampling is a sampling strategy in which the researcher chooses the sample, contacts participants, or requests volunteerism from the population; this prevents every member of the population from taking part in the study (Stratton, 2021:373). All of the technical limitations connected with probability sampling are eliminated by the random and subjective nature of non-probability sampling. The researcher will choose non-probability sampling since of the study's limitations and the subjective nature of the research.

3.7 Collection of Data

Creswell (2013:15) defines data collection as a series of planned actions for obtaining information to address research questions. As mentioned in the previous section, interviews are the primary tool utilised in qualitative research. A lot of useful information may be obtained through interviews, which can also be customised to meet your needs (Bryman *et al*., 2014:223).

The researcher approached prospective participants in person to obtain their consent to participate in the study. To collect data, the researcher conducted face-to-face or online interviews with participants identified in the inclusion criteria using video conferencing services such as Microsoft Teams or Zoom.

The researcher abided by the POPI Act concerning the potential participant's contact information by meeting the minimal standards, including accepting responsibility and ensuring the contact information is used solely for the research's legitimate and legal purposes (POPIA, 2019). The researcher complied with the POPI Act by safeguarding the confidentiality and integrity of the contact details of potential participants. High-end digital recording equipment will be used to capture the interview in audio only. Emphasis was given on the participant's ability to withdraw from the study at any moment, as it is entirely voluntary. Every participant got a notification that the data collected during the interview will remain confidential, be used only for this study, and that their identity will be protected (Bryman *et al*., 2015:127).

This study deployed a combination of semi-structured interviews as outlined in the letter (Annexure B), focus group discussions, and document analysis, each selected for its distinct advantages and synergistic capabilities.

a) **Semi-Structured Interviews**: This study utilised the semi-structured interview format by deriving questions from the literature review. In semi-structured interviews, the conversation began with a planned list of themes, accompanied by critical questions that help steer the interview's conduct, according to Saunders *et al*., (2019:437). To encourage rich data collection, the researcher employed probing to help participants elaborate on the subject.

b) **Focus Group Discussions**: Complementing the interviews were the focus group discussions. These are platforms where groups of participants engaged in a moderated dialogue. The advantage of focus groups lies in the dynamics of group interaction. Participants bounced off ideas, challenged one another, and delved into collective memories. Such discussions unearthed communal sentiments, shared challenges, and collective aspirations related to the aftermath of mine closures in the Klerksdorp region.

c) **Document Analysis**: Besides primary data, the research also delved into secondary sources like local government records, policies and laws, spatial development frameworks, Integrated Development Plans (IDP), Social and Labour Plans (SLP) and annual reports from mining companies. Document analysis offered a historical and contextual perspective, tracing the trajectory of the community's relationship with the mines.

3.8 Data Analysis

To interpret the qualitative data collected, this study employed thematic analysis, a method well-suited for identifying, analysing, and reporting patterns within textual data. Thematic analysis supports flexibility while ensuring rigour in qualitative inquiry by offering a systematic process through which themes are inductively derived from participant narratives (Naeem et al., 2024; Reyes et al., 2021). Given the depth and complexity of the interviews and focus group discussions, this analytic approach was essential for capturing the range of social and environmental experiences associated with mine closures in Klerksdorp.

Data were transcribed from audio recordings after obtaining explicit consent from participants. Transcripts were carefully reviewed, and initial coding was performed to isolate meaning-bearing units, which were later organised into broader thematic categories (Pham, 2024). The coding process was enhanced through the use of ATLAS.ti, a specialised qualitative data analysis software that facilitated efficient categorisation,

comparison, and linkage of data across interviews and document sources (Mannheimer, 2024). This digital platform supported the transparency and traceability of the analysis, which is crucial for establishing the trustworthiness of qualitative findings.

The use of ATLAS.ti allowed for an integrated approach to coding, whereby themes could be visualised across multiple data sets, including interview transcripts, field notes, and policy documents. Codes were developed inductively from the data and refined iteratively as new insights emerged, consistent with best practices in qualitative analysis (Dang et al., 2024). Data saturation was monitored throughout the process, with recurring patterns signalling the point at which additional data yielded diminishing analytical returns (Fife & Gossner, 2024).

A critical component of the analysis process was reflexivity, whereby the researcher continuously examined their positionality and potential biases during interpretation. This involved maintaining an analytic journal to document assumptions, coding decisions, and evolving interpretations, thereby increasing the transparency and ethical accountability of the study (Jamieson et al., 2023; Reyes et al., 2021). The outcome was a set of empirically grounded themes that not only reflect participants' experiences but also contribute meaningfully to theory and practice on sustainable mine closure and community resilience.

The data analysis process is represented graphically below:

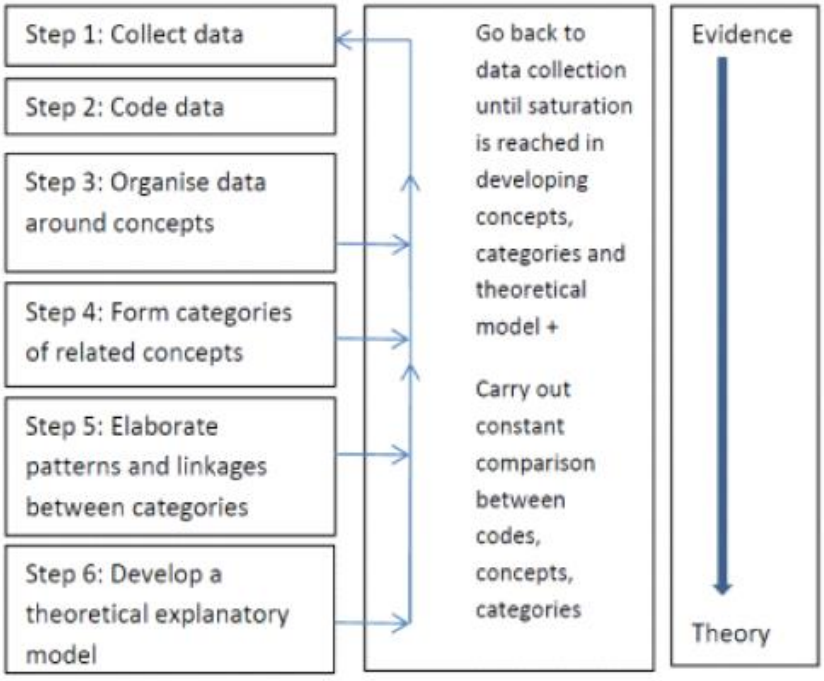


Figure 3.1: Data Analysis Process

(Source: Rambaree *et al*., 2014:3)

3.9 Reliability and Validity (Trustworthiness)

Reliability enhances the comprehension and analysis of research outcomes in qualitative research and grants others assurance regarding the calibre of an inquiry (Daniel, 2018:265). The four components of trustworthiness are confirmability, dependability, credibility, and transferability (Bryman *et al*., 2021:62).

While qualitative research, with its subjective nuances, poses unique challenges in this regard, the study adopts a multi-pronged strategy to ensure trustworthiness.

a) **Triangulation**: Borrowing from McCusker and Gunaydin's (2015) assertion, triangulation will be pivotal. It is the practice of corroborating findings through different data sources or methods. For instance, insight from a semi-structured interview can be cross-checked with findings from focus groups or documentary evidence. This convergence of evidence bolsters the robustness of the conclusions.

b) **Member Checking**: An iterative and participative process, member checking is anchored in collaboration. Post initial data analysis, the interpreted findings were presented back to the participants. This serves as a validation check. Participants could affirm, challenge, or refine the researcher's interpretations, ensuring that the final insights are authentic and resonate with the community's lived experiences (Silverman, 2016).

c) **Detailed Record-Keeping**: Transparency is at the heart of credibility. The research maintained exhaustive records of every phase, be it data collection, coding, theme generation, or interpretation. Such meticulous documentation not only provides a clear audit trail but also allows for the replication of the study, enhancing its reliability.

3.10 Ethical Considerations

Ethical approval for this study was obtained from the North-West University's Ethics Committee, Ethics Clearance Number: NWU-01776-24-A4, see Annexure D. The study adhered to the ethical principles of respect for persons, beneficence, non-maleficence, and justice throughout the research process. In conducting the empirical investigation, the researcher maintained the highest standards of integrity, accountability, and transparency to ensure that the rights, dignity, and well-being of all participants were protected.

Throughout the research process, ethical issues take front stage and help to guarantee participant rights, confidentiality, and integrity (Kirtley, 2022). Participants were fully briefed

on the aim, methods, and right to withdraw at any time without penalty (Kostere & Kostere, 2021), so informed consent was rigorously acquired and recorded. Furthermore, all data handling practices followed the highest ethical standards, including participant information rigorously safeguarded by compliance with the Protection of Personal Information Act (POPIA). From design to data analysis, the researcher should also ensure that ethical standards were applied at every level of the research.

Every study procedure that involves the gathering, handling, and archiving of personal data is impacted by the Protection of Personal Information Act (POPIA) (Adams *et al*., 2021:1). The Act affects research by ensuring that personal information is processed and that information is shared outside of South Africa (Adams *et al*., 2021:1). The Act mandates the protection of all participant rights and interests, as well as the protection of all information (Adams *et al*., 2021:1). The following outlines the ethical guidelines that the researcher will follow:

3.10.1 Informed Consent

Informed consent is the process of allowing participants to openly and voluntarily participate in a study after informing them of all research information and purpose (Manti & Licari, 2018:145). The participants were informed of their rights, including the right to withdraw from the research at any point without any repercussions. Written consent forms were provided, as shown in Annexure A, which cover all of these issues. Only post their unequivocal agreement, captured through signed consents, did the research interactions commence. The North-West University Ethics Committee under Ethics Clearance Number granted ethical approval for the consent process and the overall study: NWU-01776-24-A4 (see Annexure D).

The Department of Mineral Resource and Energy (DMRE) is a gatekeeper within this study, as it is responsible for creating and enforcing regulations regarding mine closure and rehabilitation. These regulations often outline the requirements for mine operators to plan and execute closure and rehabilitation activities, ensuring minimising environmental and social impacts and safeguarding the interests of affected communities and future generations. Permission was granted by DMRE to conduct the research and use their data regarding this study; refer to the letter provided in Annexure C.

3.10.2 Anonymity & Confidentiality

Participants' trust is important. Thus, strong mechanisms will be implemented to protect their anonymity and confidentiality. Names, addresses, and other personal identifiers will

be replaced by codes or pseudonyms in all research records. As Silverman (2016) emphasises, even when presenting findings, care will be taken to ensure that individual participants cannot be identified by specific data extracts. The research adhered to the guidelines outlined in the Protection of Personal Information (POPI) Act. The POPI Act ensures that personal information is treated with the utmost care and that the participants' rights to privacy are upheld.

3.10.3 Sensitivity in Approach

The consequences of mine closures in Klerksdorp may include socioeconomic challenges, memories of upheavals, or emotional anguish. According to Flick (2015), academics must approach such topics with caution. All questions and conversations will be approached with empathy. If a person becomes uncomfortable, they will have the ability to influence the conversation or even end it.

3.10.4 Data Security

Data protection transcends mere ethical protocol; it is a legal imperative as well. All data, whether in digital format or hard copies, was stored securely with a password. Digital data was encrypted and password protected, while physical copies, like consent forms or hand-written notes, were locked in secure cabinets with limited access.

3.10.5 Beneficence & Non-Maleficence

Rooted in the foundational principles of research ethics, the study ensured beneficence, i.e., actions that promote the well-being of participants, and non-maleficence, which entails refraining from actions that might harm participants (McCusker & Gunaydin, 2015). Not only did the study abstain from causing harm, but it also actively sook to make the research process a beneficial and enriching experience for the participants.

3.10.6 Transparency & Honesty

Research integrity was maintained through complete transparency and honesty in all stages of the study. From data collection to analysis and reporting, there was no fabrication, misrepresentation, or manipulation of data. Participants were given a transparent view of the research processes, results, and interpretations.

3.10.7 Feedback Mechanism

Ethical responsibility does not conclude with data collection. Once the research was completed, it was imperative to check back in with the community. Summaries of the

findings were shared with the participants, ensuring that they remain informed stakeholders of the study. This feedback loop not only reinforces transparency but also respects the participants' contribution.

3.10.8 Cultural Sensitivity

The Klerksdorp community, with its unique cultural, historical, and socio-economic backdrop, deserves respect and understanding. Research interactions were rooted in cultural humility, acknowledging and respecting the community's norms, values, and traditions.

3.10.9 Avoidance of Dual Relationships

Research creates the reality surrounding a topic through participation. A constructivist paradigm encourages active engagement due to power imbalances in political, economic, and social domains (Laws, Harper & Marcus, 2003). To eliminate biases or conflicts of interest, these kinds of ties were actively recognised and avoided.

3.11 Conclusion

By combining these different methods to research, we can look at the many effects of closing mines in a more complete way. Understanding the complex environmental, social, and economic effects of these changes is made easier by this approach. It provides useful information for making policies and changing the way businesses work so that communities are helped in a way that is fair and lasts. This study adds to the body of research by using both qualitative and quantitative methods. It may also help make closure and rehabilitation plans in the mining industry more successful and open to everyone (Mohajan, 2020; Zickar & Keith, 2023) in the long term.

The actual research results will be shown and talked over in the next chapter. Chapter 4 will talk about the main conclusions drawn from the interviews and other types of qualitative data, with a focus on the real-life experiences of people in the Klerksdorp area who were affected. It will also look at new themes that have come up in relation to environmental damage, economic displacement, and community resilience, connecting these discoveries to the theoretical and conceptual frameworks set up in earlier parts. This development will lay the groundwork for the suggestions and real-world effects talked about in Chapter 5.

CHAPTER 4: DATA ANALYSIS & DISCUSSION

4.1 Introduction

Chapter 4 examines how mine closures and unrehabilitated mines affected Klerksdorp. Semi-structured interviews with locals, community leaders, and stakeholders are linked to literature and theoretical frameworks in this chapter. It is vital to analyze how mine closures have affected environmental deterioration, social instability, and policy enforcement in the region. The chapter investigates research problems from previous sections, highlighting mining cessation's complicated effects.

The investigations examine air, water, and biodiversity loss from unrehabilitated mines. Cole and Broadhurst (2020) observed comparable issues in South African mining rehabilitation. Interviewees said mine dump dust and polluted water supplies hinder agricultural production and human health, especially in surrounding villages. Mhlongo (2023) agrees, citing South Africa's unrehabilitated mines' environmental issues. However, stakeholder perception discrepancies highlight awareness and accountability gaps, a chapter topic.

Due to mine closures, unemployment, household wages, and small businesses have collapsed, causing social concerns. Economic instability has worsened social inequalities, putting marginalised groups at risk. This analysis supports Nwaila (2021)'s mine closures cascade local economic claim. As Marais et al. (2024) noted, some stakeholders advised local economy diversification to lessen mining dependence during interviews. This chapter explores various perspectives to show the complex relationship between economic dependency on mining and the need for sustainable alternatives.

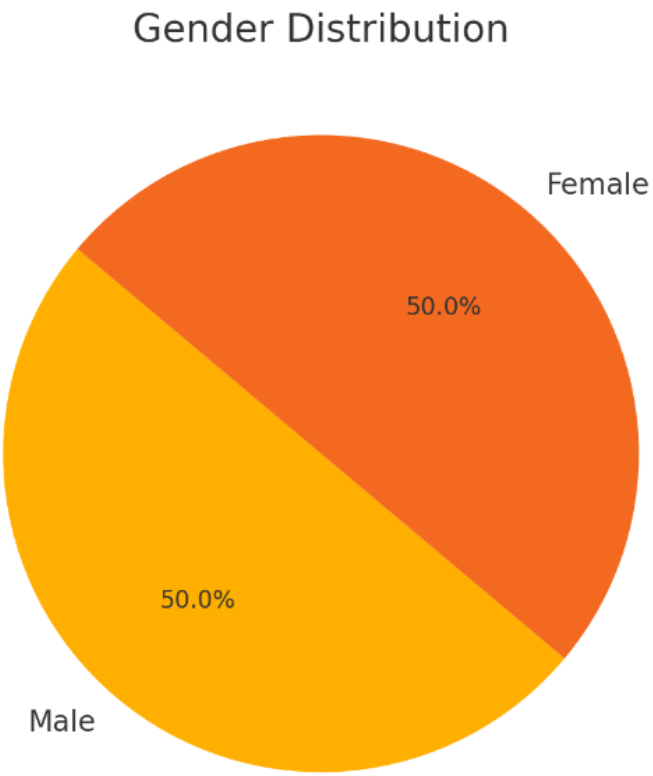
Policy and governance are crucial, as the study found substantial mine rehabilitation enforcement gaps. Like Kuipa (2023), participants criticised mining corporations' lack of accountability and the legislative framework's poor implementation. The National Environmental Management Act promotes sustainable development, yet enforcement is inconsistent, leaving communities unfulfilled. To analyse their connection with global sustainability goals, this chapter compares mining operations to the SDGs.

4.2 Demographic Profile of Participants

4.2.1 Gender Distribution

The gender distribution of study participants shows inclusion. Table 4.1 displays 50% male and 50% female respondents.

Table 4.1: Gender Distribution



Equal gender distribution underlines this study's balanced perspectives. Men and women were equally affected by mine closure socio-economic and environmental challenges, offering a complete perspective. Cole and Broadhurst (2020) stress the need for gender-balanced data collection to understand mining's multidimensional effects.

Mine closures affect men and women differently, according to gender-based assessments. Unemployment and limited access to key services damage women disproportionately, according to Nwaila (2021). Mining job losses may make it hard for men to support their families (Makgetla et al., 2019). The study shows that both genders see mine closures as hazardous to their health and economic stability.

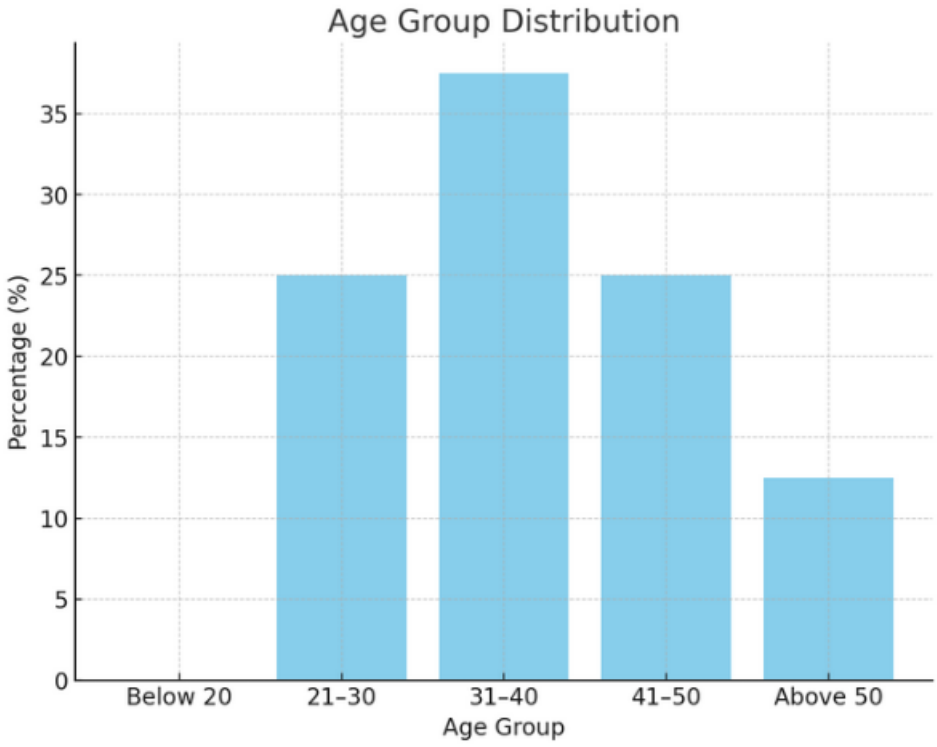
This study had balanced involvement, unlike previous mining research studies that were male-dominated (Mhlongo, 2023). An inclusive approach deepens our research by including varied experiences and issues faced by men and women in mining host

communities. Further research should prioritise gender representation to ensure that mining policy and rehabilitation initiatives meet the requirements of all affected parties.

4.2.2 Age Group Distribution

The age distribution of responders shows how mine closures and unrehabilitated mines affect generations. The participant age demographics are shown in Table 4.2.

Table 4.2: Age Distribution



The majority of participants (37.5%) are 31–40 years old, followed by 21–30 and 41–50 (25% each). A mere 12.5% of responders were above 50. These statistics indicate that this study mostly includes economically active people. This demographic is especially affected by mine closures since they depend on mining jobs.

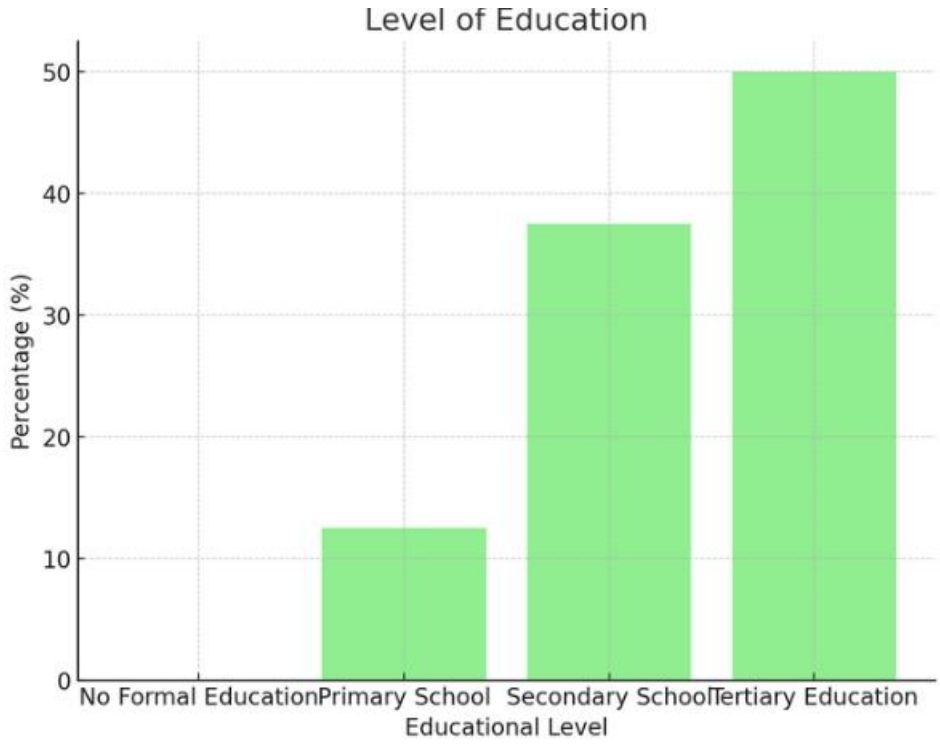
Cole and Broadhurst (2021) found comparable tendencies in mining host communities, with younger and middle-aged respondents. These populations are more likely to have dependents and participate in local economies, making them vulnerable to job losses and environmental hazards. The under-representation of older age groups may suggest disengagement with community issues or a preference for younger participation in such studies (Marais et al., 2024). Data confirms Laker's (2023) claim that mine closures cause socio-economic instability in the 21–40 age cohort. Due to their mining-related employment, this cohort struggles to switch careers. This study highlights the need for

tailored initiatives, such as skills development and employment diversification programs, to benefit these groups.

4.2.3 Level of Education

Educational attainment among participants varied widely. Those with higher education levels tended to articulate more clearly the inadequacies of policies and corporate responsibility, while those with limited education focused more on immediate hardships, such as poverty, unemployment, and environmental health problems affecting their families. Table 4.3 shows respondent education levels.

Table 4.3: Level of Education



Half of the participants (50%) had tertiary education, 37.5% secondary, and 12.5% primary. There were no unschooled responses. This suggests a high reading level in the research area, which may affect participants' understanding and engagement with mine closing issues.

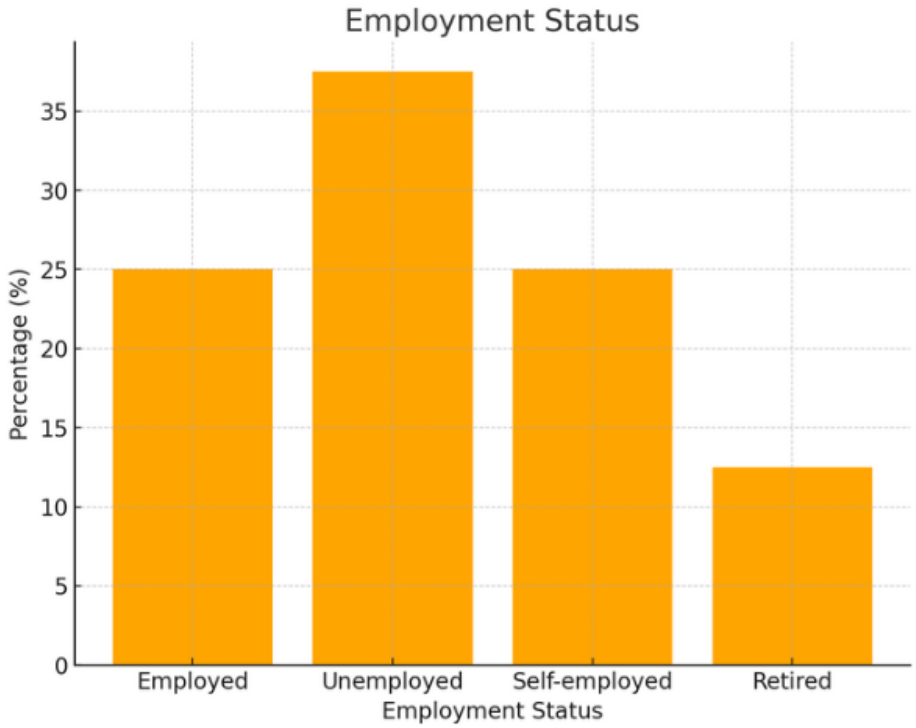
In contrast, Marais and Matebesi (2024) found lower education levels in some South African mining host communities. Klerksdorp's high educational attainment may be due to its history of mining-related technical and professional professions, which demand formal qualifications (Nene, 2019). Dzimiri (2024) found that higher education increases environmental and socio-economic awareness. This study shows that educated respondents support sustained rehabilitation and policy improvements. However, the low

basic school representation underscores the necessity for inclusive communication tactics to ensure that all community members understand and contribute to post-closure initiatives.

4.2.4 Employment Status

Most participants were unemployed or working informally, having previously been employed in or reliant on the mining sector. Their narratives highlighted the profound socio-economic dislocation caused by mine closures, particularly the lack of alternative employment opportunities and the psychological toll of prolonged unemployment. Table 4.4 shows participant employment dispersion.

Table 4.4: Employment Status



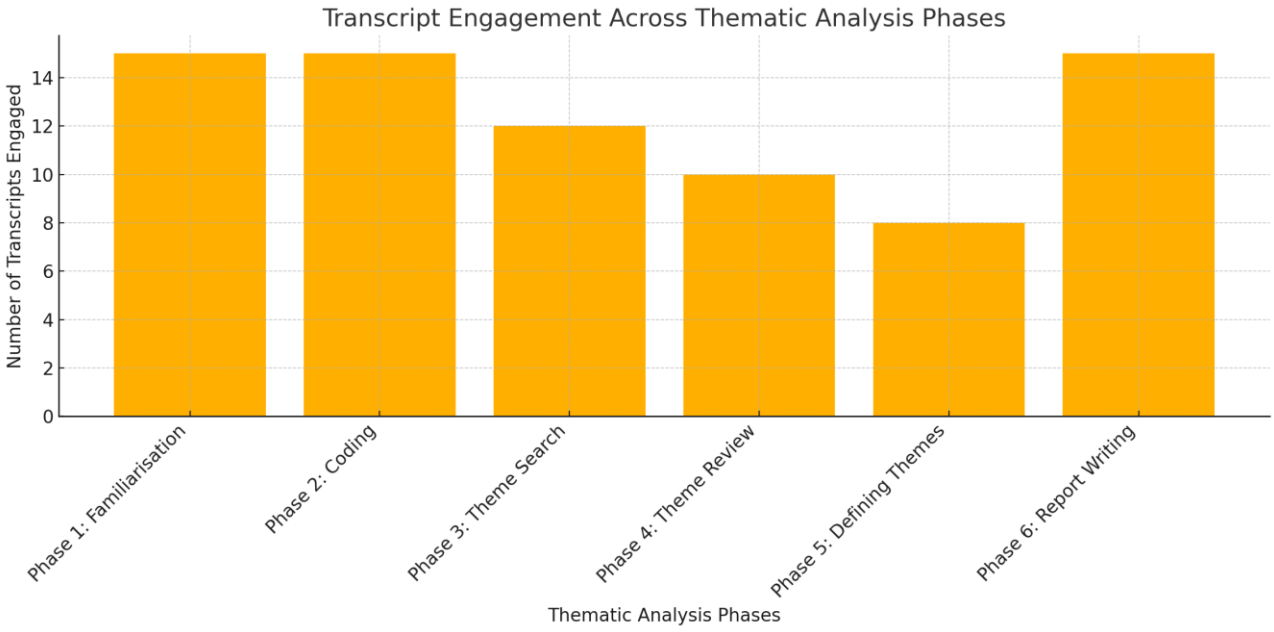
The most common status was unemployment (37.5%), followed by employment and self-employment (25% each). The sample had 12.5% retirees. These results show that mine closures have hurt the community's economy by reducing jobs.

These findings support Cole et al. (2024) and Kuipa (2023) findings of substantial unemployment in post-closure mining areas. As seen worldwide, transitioning from mining-dependent economies to diversified lives is difficult (Measham et al., 2024). The incidence of self-employment in this study implies a rising reliance on informal economic activity as formal employment declines. The findings emphasise the need for job-creation and skills-development strategies. Providing communities with alternative livelihoods is essential for

long-term socio-economic stability in post-mining regions, according to Cornelissen et al. (2019).

4.2.5 Thematic Analysis Process and Interpretation

Table 4.5: Thematic Analysis Phases



Thematic analysis was adopted in this study to identify, analyse, and interpret patterns of meaning (themes) from the qualitative data collected through semi-structured interviews, focus groups, and document reviews. The process followed Braun and Clarke's six-phase framework. In Phase 1, "Familiarisation," the researcher immersed themselves in the data, repeatedly reading 15 full transcripts to gain a deep understanding of the narratives. Initial impressions and recurring issues were recorded in a reflective journal, helping shape preliminary ideas. This step laid the foundation for an inductive approach where meaning emerged from the participants' voices, aligning with the constructivist paradigm underpinning this research (Bell et al., 2022; Dang et al., 2024). The use of ATLAS.ti software aided in organising the transcribed data, especially in tagging and searching emerging patterns within textual units.

In Phase 2, "Coding," the researcher systematically identified meaningful data segments across all 15 transcripts. Using line-by-line coding, labels were generated to summarise core ideas, such as "community displacement," "environmental toxicity," and "loss of livelihood." These codes were directly linked to research questions and theoretical frameworks, including the SDGs and socio-environmental resilience theory. By the end of

this phase, over 90 initial codes were created. The ATLAS.ti software enabled efficient comparison of these codes across respondents, enhancing reliability and consistency. Reflexive notes were maintained to trace researcher positionality and reduce interpretive bias, as recommended by Reyes et al. (2021). Codes that were repeated or strongly expressed by multiple participants were prioritised for further analysis.

Phase 3 involved “Theme Searching,” where codes were organised into broader categories to develop candidate themes. Of the initial 90 codes, 45 were clustered under thematic umbrellas such as “post-mining vulnerability,” “institutional failure,” and “adaptive resilience.” This stage required interpretative depth, as the researcher shifted from descriptive tagging to conceptual abstraction. Codes were tested for internal homogeneity and external heterogeneity to ensure each theme held together meaningfully and stood distinct from others (Naeem et al., 2024). Several diagrams and coding trees were generated using ATLAS.ti to visualise the relationship between themes. This helped in clarifying overlaps and refining theme boundaries. The goal was to construct themes that reflected both the breadth and depth of participant experiences while remaining grounded in the raw data.

During Phase 4, “Reviewing Themes,” the researcher revisited both the coded data extracts and the full dataset to validate the themes’ coherence. At this point, three themes were discarded due to insufficient supporting evidence, narrowing the thematic structure to ten robust themes. Examples of these include “Delayed Rehabilitation as Structural Violence” and “Livelihood Transition Failures.” Internal consistency was checked by mapping each theme back to specific research questions. Memos were written to summarise what each theme represented and how it contributed to understanding the effects of mine closures in Klerksdorp. Participant quotations were attached to each theme node to preserve the authenticity of voices and ensure analytical transparency (Pham, 2024). Only themes supported by multiple respondents across age, gender, and employment groups were retained for final analysis.

In Phase 5, “Defining and Naming Themes,” the focus shifted to articulating the core narrative of each theme. This entailed writing analytical summaries and creating thematic matrices to show the variation of subthemes. For instance, under “Environmental Hazards,” subthemes included “airborne particulates,” “acid mine drainage,” and “groundwater contamination.” Thematic definitions were refined to align with theoretical constructs like environmental justice and socio-economic resilience. Careful attention was

paid to ensure that theme names were concise, evocative, and analytically rigorous. The analytical narrative for each theme was constructed to tell a coherent story of how mine closures disrupted community life, drawing from both empirical data and literature (Fife & Gossner, 2024). Each theme was designed to be analytically useful and capable of offering policy-relevant insights.

Phase 6 involved “Report Writing,” where the themes were woven into the broader structure of Chapter 4. Representative quotes from participants were used to ground each theme in lived experiences. The narrative was structured to address each research question while illustrating how the themes interrelated. Themes were contextualised within the theoretical framework discussed in Chapter 2, especially regarding the SDGs, governance failures, and environmental degradation. Visual aids like graphs and coding trees were integrated to enhance interpretive clarity. The analysis drew strong links between stakeholder perceptions and policy frameworks, demonstrating how poor regulatory enforcement exacerbates social vulnerability. Finally, the chapter concluded by identifying gaps in current rehabilitation approaches and suggesting areas for policy intervention and further research.

To visualise the most salient and frequently mentioned terms in the dataset, an aggregate Word Cloud was generated using all coded transcripts. The Word Cloud served as a complementary visual tool to highlight the key words and concepts that dominated the participants’ narratives. Larger and bolder words indicate higher frequency and centrality in the discourse, while smaller words reflect less frequent yet still notable aspects of the discussions.

Word Cloud Highlights

The Word Cloud revealed the following dominant terms, which align with the major themes identified through thematic analysis:

Figure 4.1: Aggregate Word Cloud – Thematic Analysis

(Source: ATLAS.ti software)

- Unemployment: Reflecting the widespread economic hardship and job losses experienced by residents after mine closures.
- Pollution: Highlighting environmental degradation, particularly air and water contamination from unrehabilitated sites.
- Health: Underscoring the adverse effects of mining-related pollution on public health, including respiratory and waterborne diseases.
- Community: Emphasising the collective impact on social cohesion, resilience, and local identity.
- Rehabilitation: Capturing participants' perceptions of inadequate or absent efforts to restore mining-affected land.
- Poverty, Water, Dust, and Policy also featured prominently, pointing to intersecting concerns about governance, environmental management, and quality of life.

The Word Cloud not only supports the identified themes but also illustrates how participants framed their experiences and priorities, providing a visual summary of the qualitative findings. This visualisation reinforces the interpretivist commitment to presenting data in a way that reflects the voices and perspectives of those most affected by the phenomena under study.

4.3 Analysis of Research Questions

The findings are organised around the five research questions, with themes and sub-themes identified in participants' narratives.

4.3.1 Environmental Hazards

The main environmental risks of unrehabilitated Klerksdorp mines are discussed here. It examines environmental hazards, air pollution, water contamination, and findings dependability using collected and analysed data. With statistical data and literature comparisons, each sub-section is thoroughly analysed.

4.3.1.1 Perceived Threat to the Environment

Mining host communities worry about unrehabilitated mines threatening the environment. Participants' perceived dangers are mentioned below.

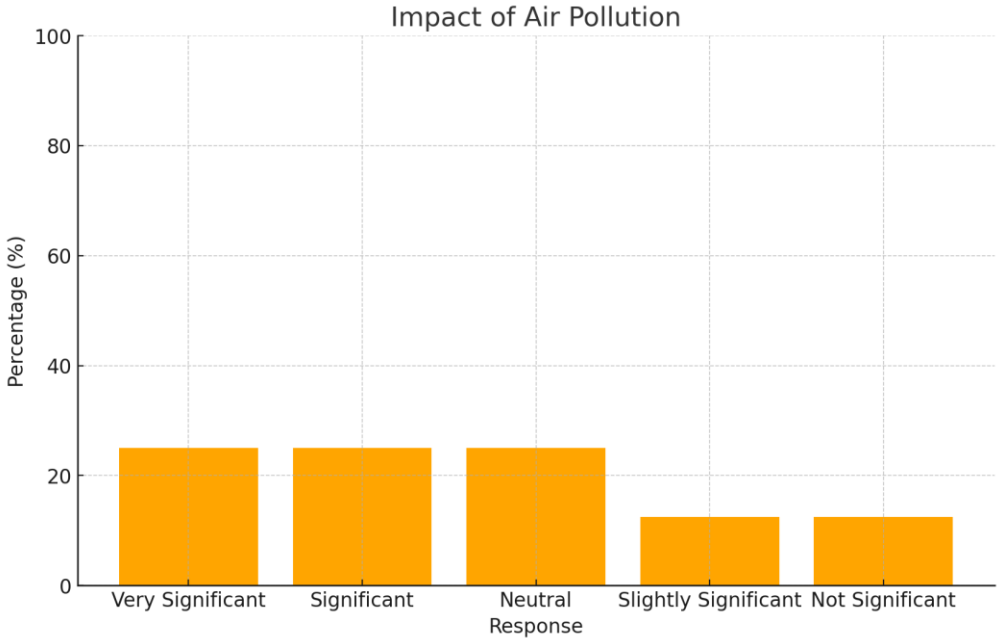
Results show that 87.5% of respondents agreed or strongly agreed that unrehabilitated mines are environmentally harmful. Only 12.5% were neutral, demonstrating a consensus on abandoned mines' negative consequences. Nwaila (2021) found comparable perceptions in South Africa's gold mining districts, where abandoned tailings have caused serious environmental deterioration.

These data support Kuipa (2023)'s claim that unrehabilitated mines cause soil contamination, ecosystem disruption, and biodiversity loss. However, Chanda-Kapata (2020) observes that socio-economic vulnerabilities can influence community attitudes, requiring additional research into their causes. This study's high agreement rate emphasises the need to address unrehabilitated mines' environmental hazards. These hazards must be mitigated and community confidence in mining restored through effective rehabilitation and policy enforcement.

4.3.1.2 Air Pollution Impact

A recurring theme was the respiratory problems reportedly linked to dust from unrehabilitated sites. Several participants attributed chronic coughs, asthma, and other illnesses in their families to poor air quality. Table 4.6 shows participants' Klerksdorp air pollution perceptions.

Table 4.6: Impact of Air Pollution



Air pollution was considered significant or very significant by 50% of respondents, underlining its critical impact on the community. The remaining responses were evenly neutral, somewhat significant, and not significant, indicating exposure or awareness. Cole and Broadhurst (2020) found that air pollution affects depend on mining site location and wind patterns.

Laker (2023) noted that particulate matter and hazardous emissions from unrehabilitated mines damage air quality in mining districts. They disagree with Makgetla et al. (2019), who found that community concerns over air pollution were generally secondary to unemployment and poverty.

4.3.1.3 Water Contamination Perception

Respondents described how streams and groundwater had become discoloured and foul-smelling, with many fearing long-term health consequences from using this water. Some lamented the loss of previously arable land due to contamination. This fits with what Nwaila found in 2021: water bodies near abandoned mines are polluted all over South Africa, including places like Klerksdorp, where pits and tailings dams that haven't been fixed up keep leaking dangerous chemicals into nearby water systems. Acid mine drainage (AMD) is a big problem in Klerksdorp. Cole et al. (2022) say that it pollutes water sources over time, making them unsafe for people to use and for the ecosystem to balance.

The people who took part in the study said that AMD was the main cause of pollution in their area, making it the most important environmental problem that was looked at.

Kuipa (2023) says that water pollution has been caused by poor clean-up efforts and lax enforcement of environmental laws. This is exactly what happened in the Klerksdorp mining areas. People who took part ranked the lack of enforcement as the second most important reason. They gave examples of mine operators not closing down as required. This lack of care makes pollution worse and weakens the community's ability to bounce back. AMD and regulatory problems are at the top of the list of problems, but members also said that getting clean water for daily use was a major issue that needed to be fixed right away, ranking it third. These results show how bad the problem is in Klerksdorp and how important it is to focus on reducing AMD, enforcing the law more strictly, and using long-term water management methods.

4.3.2 Socio-Economic Impact

This section examines how mining closures in Klerksdorp affect employment, economic stability, and well-being. Descriptive and dependability statistics are used to analyse each variable, revealing host communities' problems.

4.3.2.1 Impact on Employment Opportunities

All participants described the massive loss of jobs and livelihoods following mine closures. This theme was often accompanied by feelings of despair, shame, and diminished social status among former mine workers. Mine closures reduced employment chances greatly or tremendously for 50% of respondents, while 25% saw a moderate impact. The remaining 25% had little effect. These data show that mining closures severely impact local job markets. According to Cole and Broadhurst (2021), the mining sector is a major employer in many South African areas, and its decrease worsens unemployment and underemployment.

Comparatively, Nwaila (2021) found that South African gold mine closures have caused prolonged unemployment, disproportionately affecting low-skilled workers. According to Makgetla et al. (2019), mining-dependent communities generally lack alternative employment, increasing socio-economic vulnerabilities. However, Marais et al. (2024) suggest proactive planning and skills training can reduce these effects. Post-mining communities need economic diversification and workforce retraining policies, according to

these findings. Investing in agriculture and renewable energy might provide sustainable jobs and lessen mining dependence.

4.3.2.2 Economic Instability

Economic instability is a significant post-closure challenge for communities affected by mine closures. The survey data presented in Table 4.7 indicates that 50% of participants agreed that mine closures directly contributed to economic instability in Klerksdorp, while 25% were neutral, and another 25% disagreed. These mixed responses suggest that while many perceive a direct economic impact, some attribute the challenges to other external factors, such as regional economic downturns or mismanagement. Kuipa (2023) highlights that global commodity price volatility and inadequate policy responses exacerbate economic instability in post-mining communities, a sentiment echoed in participant narratives.

Table 4.7: Economic Instability Perceptions

Response	Percentage
Agree	**50%**
Neutral	**25%**
Disagree	**25%**

Laker (2023) noted that mining tax and royalty cuts hurt local government budgets and hinder key services. Financial strain in Klerksdorp has degraded infrastructure and curtailed community welfare investment. Marais et al. (2024) also blame reduced consumer spending and supply chain disruptions for local business and employment losses. To mitigate these effects, Chanda-Kapata (2020) suggests investing in post-mining infrastructure, tourism, and varied economic activity. Klerksdorp's mining history could be used to generate heritage tourism projects, perhaps earning new cash.

The data show that post-closure economic instability requires government, corporate, and community involvement. Sustainable economic planning must emphasize resilience through diversity and long-term investments in skills, entrepreneurship, and regional economic integration. The closure and restoration process has aroused serious concerns,

therefore they should be separated from post-closure community impacts, which are more specific and immediate. Future studies should focus on inclusive and participatory post-closure plans for Klerksdorp.

4.3.2.3 Well-being Impact

Participants who took part often talked about problems with their mental health, falling living standards, and limited access to health care services. Cole and Broadhurst (2020) found similar trends in mining host communities around the world, such as rising mental health problems and falling living standards. However, these results in Klerksdorp are based on local perceptions that was gathered for this study, making them unique to the region.

Unemployment and economic uncertainty increased depression and substance misuse in Klerksdorp, as Nwaila (2021) found in other South African mining regions. Mhlongo (2023) also noted that unrehabilitated mines' water contamination and air quality decline contributed to physical health decline. Participants also noted the lack of mental health resources and community-based help initiatives, which increases isolation and vulnerability. Community support networks and resilience building can reduce such consequences, according to Dzimiri (2024). These findings emphasize the importance of social well-being in Klerksdorp post-closure planning.

The findings underscore that mine closure initiatives must include mental health, housing, and education programs in Klerksdorp. General mining community patterns are useful, but Klerksdorp's socio-economic and environmental constraints require specialized responses. Future efforts should include community-driven programs suited to the area's requirements, including social support within closure and rehabilitation frameworks.

4.3.3 Post-Operational Rehabilitation Measures

Mining entities in Klerksdorp conducted post-operational site rehabilitation methods that focused on awareness, effectiveness, sustainability, and reliability. The findings are reported using descriptive, reliability statistics, and literature comparisons.

4.3.3.1 Awareness of Rehabilitation Measures

Understanding rehabilitation measures is critical for evaluating their effectiveness and ensuring community participation in restoration initiatives. The results presented in Table 4.8 indicate that 50% of respondents were aware or extremely aware of mining restoration initiatives, 25% were neutral, and 25% were unaware. These findings suggest that

community awareness of rehabilitation efforts remains modest in the Klerksdorp area. Cole et al. (2022) argue that public awareness is often linked to the use of inclusive communication strategies by mining firms, highlighting the importance of transparent and proactive engagement. According to current data, Klerksdorp's platforms are restricted and more PR-focused than participatory.

Table 4.8: Awareness of Rehabilitation Measures

Awareness Level	***Percentage***
Aware/Extremely Aware	***50%***
Neutral	***25%***
Unaware	***25%***

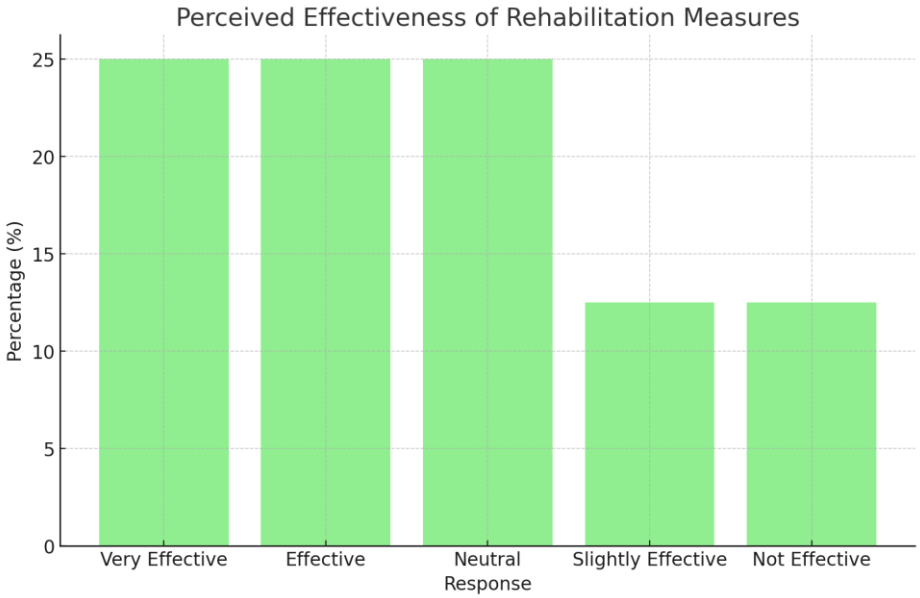
Kuipa (2023) found that restoration efforts are less understood when mining companies and local stakeholders don't talk to each other enough. This seems to be the case in Klerksdorp as well. Participants said that knowledge about rehabilitation measures is often hard to find or too technical, which makes it hard to get involved in a meaningful way. Nene (2019) says that simplified educational campaigns and focused outreach programs can make the public much more aware of restoration efforts and help people in the community understand their scope and goals.

In Klerksdorp, these results show how important it is to move from basic communication to full stakeholder involvement. Mining companies need to set up platforms that allow everyone to talk, share reports on progress, and ask for feedback. Clear communication not only raises knowledge, but it also builds trust, which makes it easier for the community to get involved and holds people more accountable in rehabilitation efforts. Awareness-raising activities like community talks and visual displays of rehabilitation progress could be very helpful in closing the knowledge gap and getting local stakeholders involved in the restoration process.

4.3.3.2 Perceived Effectiveness of Rehabilitation

Most respondents felt that rehabilitation efforts were minimal and largely ineffective, perceiving them as tokenistic and failing to restore land to safe or productive use. Participants rate these measures' efficacy in Table 4.9.

Table 4.9: Perceived Effectiveness



Fifty percent of those who answered thought the recovery measures worked or worked very well. Twenty-five percent were neutral, and twenty-five percent were skeptical. These different answers show that therapy is done in different ways and has different results. De Koker (2020) says that communities see success as connected to environmental and economic benefits based on what they see.

Makgetla et al. (2019) say that different mining companies have different levels of recovery programs that do not meet government standards. This leads to different outcomes. Mhlongo (2023) agrees that poor monitoring and enforcement hinder rehabilitation efforts. These findings show that mining companies must use standardised and verifiable rehabilitation methods to rebuild community trust.

4.3.3.3 Sustainability of Measures

Participants' concerns reflect broader challenges faced by mining corporations globally. According to Cole and Broadhurst (2021), many companies struggle to balance environmental, social, and economic priorities in their rehabilitation strategies, often leading to unsustainable outcomes. Nwaila (2021) underscores that achieving

sustainability requires substantial financial investment and strict adherence to well-defined closure plans. Inadequate resources and misaligned priorities frequently undermine the effectiveness of rehabilitation programs. Edwards and Maritz (2019) caution against cost-cutting measures that prioritize short-term gains, emphasizing that such practice fail to address the root causes of environmental degradation and community disempowerment.

For the Klerksdorp region, the study highlights the need for holistic and community-centered approaches to sustainability. Rehabilitation efforts must integrate environmental restoration, socio-economic stability, and stakeholder engagement to ensure lasting impacts. This requires collaborative frameworks where mining companies, local governments, and affected communities co-develop and implement sustainable strategies. Community ownership of rehabilitation initiatives, alongside transparent funding and accountability mechanisms, can significantly improve the sustainability of measures in the long term. As the findings suggest, achieving true sustainability will depend on addressing immediate challenges while laying the groundwork for resilient, adaptive systems that meet both present and future needs.

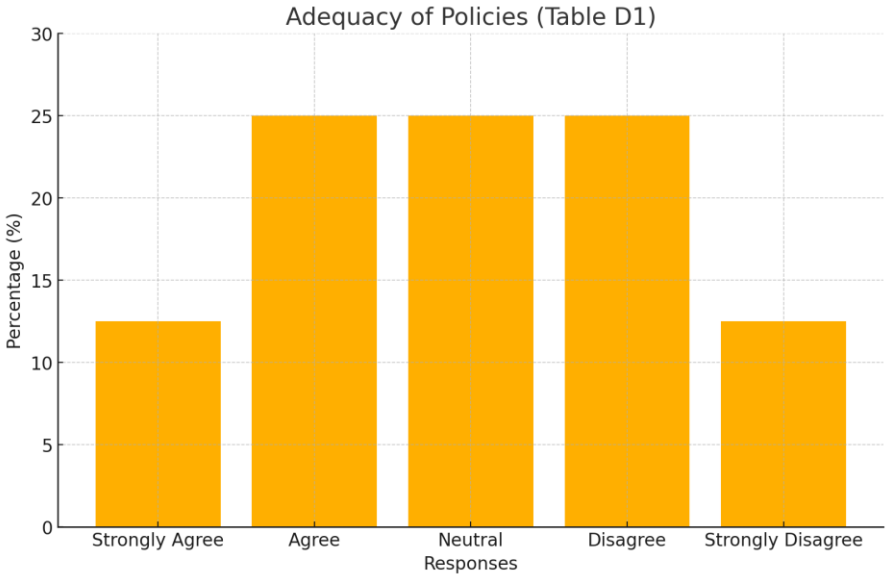
4.3.4 Policy Framework

This section assesses the present mine closure and unrehabilitated mining policy framework for adequacy, sufficient, and sustainability. The research suggests changes to close gaps.

4.3.4.1 Adequacy of Policies

Adequacy of policies relates to how well existing frameworks solve mine closure issues. Table 4.10 summarises replies.

Table 4.10: Adequacy of Policies



With 25% of respondents agreeing, being neutral, or disagreeing with policy adequacy. These conflicting opinions show that stakeholders are both satisfied and sceptical of the policy environment. According to Nene (2019), stakeholder views on South Africa's mine closure legislation vary. Cole and Broadhurst (2021) noted that while frameworks like the Mineral and Petroleum Resources Development Act (MPRDA) provide a legislative base, their execution often lacks coherence, especially in addressing site-specific difficulties. The poor execution of rehabilitation mandates, according to Edwards and Maritz (2019), increased stakeholder mistrust. This study emphasises the need for better policy articulation and implementation to boost stakeholder confidence.

4.3.4.2 Sufficiency of Regulations

Regulation sufficiency determines whether rules support sustainable development. Participants felt that existing regulations seemed sufficient on paper but lacked the necessary implementation and monitoring to make a real difference.

Half of respondents assessed the regulations as sufficient or slightly sufficient, and 12.5% very sufficient. However, 25% were neutral, and 12.5% thought the measures were inadequate. According to Mpanza et al. (2021), regulatory framework inadequacies hinder mine rehabilitation and sustainable development.

Laker (2023) noted that regulations often prioritise compliance over outcomes, resulting in shallow policy application. However, Makgetla et al. (2019) claimed that monitoring

existing regulations could strengthen rehabilitation efforts. This study shows that regulatory frameworks must be refined to handle practical issues and ensure sustainable outcomes.

4.3.4.3 Policy Needs Perception

Policy amendment is strongly supported by the participants. This shows broad recognition of framework inadequacies, along with Kuipa (2023), who found that outmoded or poorly enforced policies often fail to address rising mine rehabilitation concerns.

Dzimiri (2024) suggested that effective policy frameworks should prioritise long-term sustainability and community input, which present regulations often lack. According to Cole et al. (2024), policy must adapt to changing socio-economic and environmental conditions. These findings emphasise the need for policy reforms that reconcile regulatory obligations with community needs and sustainability aims.

4.3.5 Alignment with Sustainable Development Goals (SDGs)

Respondents overwhelmingly felt that current practices were misaligned with sustainable development principles, citing ongoing harm to both people and the environment. Participants called for mining practices that prioritise long-term community well-being and environmental restoration.

4.4 Qualitative analysis

4.4.1 Research Question: a) What are the predominant environmental hazards associated with unrehabilitated mines in Klerksdorp?

Semi-structured interview analysis reveals that unrehabilitated mines in Klerksdorp pose significant environmental hazards, including air, water, and soil contamination. Participants consistently reported pervasive dust pollution exacerbated by wind, which negatively affects respiratory health, particularly among children and adults in nearby communities. Streams and boreholes near abandoned mining sites exhibit discoloured water with chemical odors, rendering them unsafe for consumption, agriculture, or other domestic uses. These findings highlight the multifaceted nature of environmental hazards in the region, emphasizing both the physical and ecological challenges faced by local populations.

Participant Responses

“The water pollution here is just… terrible. Rivers are visibly dirty, and you can even smell something metallic near some water sources. Dust from the mine dumps is everywhere—especially on windy days. My childrens cough a lot more during those times.” (Participant 1)

“The streams close to the old mines? They have this weird orange color, and we’ve noticed dead fish here and there. The air, it’s really dusty, and it feels like you’re breathing in the mine itself.” (Participant 7)

“People in the informal settlements are closer to the mine dumps. They don’t have proper housing or clean water, so they suffer the most from the pollution.” (Participant 6)

“There were talks of planting grass or fencing off areas, but honestly, nothing substantial has happened. The dust still blows everywhere, and the water is still polluted.” (Participant 5)

“When the wind picks up, it’s just terrible. Some days it’s like you can even taste the dust in your mouth. The water nearby is discolored and has a chemical smell.” (Participant 3)

The findings reveal that dust pollution is the most widespread and immediate concern in Klerksdorp. Residents frequently cited respiratory issues exacerbated by dust from mine dumps, which affects daily living conditions and health outcomes. Water contamination, characterized by discoloration and chemical odors, was also highlighted as a significant issue, particularly in informal settlements with inadequate housing and limited access to clean water. These communities, often located closest to mine dumps and open shafts, bear a disproportionate burden of environmental degradation, further deepening social inequities.Participants condemned mining corporations' cosmetic and unsustainable mitigation initiatives including planting greenery or watering mine dumps. Participant feedback indicated that dust and water contamination reduction initiatives were not scaled or sustained. Physical dangers like open mining shafts increase safety and environmental problems for these populations.

The data support Cole and Broadhurst's (2021) claim that mine tailings and dumps cause most air and water pollution in mining zones. In Klerksdorp, inadequate hazardous material containment exposes people to respiratory and waterborne infections, according to Nwaila (2021). Laker (2023) claims that plant cover and water treatment have improved

mining conditions. In contrast, Klerksdorp inhabitants report that these policies are poorly implemented or sustained, limiting local impact.

Kuipa (2023) also emphasizes the necessity for a strong and enforceable rehabilitation framework for long-term environmental recovery. Participants observed little community involvement in rehabilitation planning and implementation, echoing Chanda-Kapata's (2020) criticism that affected people are generally sidelined from decision-making. Exclusion reduces intervention efficacy and reinforces environmental inequalities, leaving underprivileged populations exposed to unrehabilitated mines.

The findings highlight Klerksdorp's urgent need for thorough and inclusive rehabilitation. Dust suppression, water purification, and mining shaft closure should be prioritized in these methods. Community involvement in rehabilitation planning and implementation can improve accountability and ensure that solutions meet local needs and challenges. These strategies are essential for lowering environmental dangers from unrehabilitated mines and enhancing community well-being.

4.4.2 Research Question: b) What measures have been implemented by mining entities for post-operational site rehabilitation? Are they sufficient and sustainable?

Many people thought that the steps that mining companies took to fix up sites after they were done using them weren't enough and wouldn't last. People were seen planting trees and putting up fences around dangerous areas, but these actions were seen as short-term and did not help the environment or the community in the long run. The main issues that were talked about were not enough planning, bad handling of rehabilitation projects, and not enough community involvement.

People who took part said that trying to grow grass and plants on mine dumps usually didn't work since the dirt wasn't good enough. They also said that fencing off abandoned mines didn't do much to protect the environment from problems like air pollution and polluted water. The feeling was that mining corporations were reluctant to invest enough money for rehabilitation, and existing efforts were considered as legal responsibilities rather than genuine environmental protection.

The repeated frustrations showed that these policies failed to alleviate environmental issues. Tailings dust and polluted water supplies continually affected community health and livelihoods. Many participants complained about the rehabilitation process's lack of transparency and independent monitoring and reporting.

Responses from Participants

"They've planted some grass around the mine dumps, but it doesn't survive since the soil is still contaminated. It feels like they're doing it just to say they've done something." (Participant 2)

"The fences they've put up don't stop the dust or clean the water. It's like putting a plaster on a broken arm." (Participant 4)

"Rehabilitation should make the land usable again for farming or other activities, but right now it's just left abandoned." (Participant 5)

"They've started some projects but abandoned them halfway. We see no real commitment to making the land sustainable." (Participant 7)

"The dust and water pollution are still here. Whatever they're doing, it's not making a difference for us who live nearby." (Participant 6)

Dissatisfaction with rehabilitation scope and quality was evident in participant replies. Many criticised cosmetic measures like planting grass, which won't persist without addressing soil and water degradation. Mining corporations' mid-project abandonment shows a lack of accountability and follow-through. The inability to restore the land to a productive or safe state calls into doubt the viability of these actions. Participants noted that airborne dust and contaminated water supplies from unrehabilitated sites cause chronic respiratory concerns and limited access to clean water. Due to the lack of integration between rehabilitation efforts and community needs, participants often complain about the lack of local resident consultation or meaningful involvement in planning.

The stated lack of transparency in rehabilitation efforts and insufficient policy enforcement causes mistrust and disempowerment in impacted communities. Participants want independent monitoring to guarantee rehabilitation initiatives are performed and maintained.

This study confirms previous findings on South Africa's mining sector's post-operational rehabilitation issues. Mining corporations claim to undertake rehabilitation, but Sibanda (2021) adds that the activities are mostly performative and fail to address the core causes

of environmental deterioration. Kuipa (2023) also points to inadequate long-term rehabilitation funding as a systemic issue that leads to ineffective interventions.

Cole and Broadhurst (2022) suggest that sustainable restoration needs soil remediation, water treatment, and reforestation to make land suitable for agriculture or housing. This study confirmed similar findings, as participants stressed the need for comprehensive and durable methods beyond surface-level treatments. Research shows inconsistent policy frameworks and execution. De Koker (2020) claims current rehabilitation laws are too vague and unenforceable to hold mining companies accountable. Participant concerns include lack of monitoring and ineffective activities.

This study reveals that Klerksdorp rarely involves the community in rehabilitation, despite Chanda-Kapata (2020). Rehabilitation is hampered by lack of consultation, which breeds mistrust between mining companies and affected.

4.4.3 Research Question: c) Does the current policy framework encourage sustainable development, or does it require modification?

Semi-structured interviews indicated concerns about South Africa's mining district sustainable development policies. Participants complained about the policy framework's lack of enforcement instruments, stressing the gap between published and implemented policies. They discovered accountability gaps, especially for mining companies that leave sites unrehabilitated after closures. Many respondents noted the lack of harsh disobedience consequences.

Participants often mentioned corruption and insufficient monitoring, suggesting authorities lack the means or political will to ensure compliance. The policy's failure to require pre-closure rehabilitation was another major criticism, with many saying rehabilitation is an afterthought in mining operations. Excluding community voices from policy creation left affected regions feeling abandoned and unable to demand significant reforms.

Participants' Responses

“The policies look good on paper, but enforcement is a different story. Mining companies find ways to avoid their responsibilities” (Participant 3).

“There are no strict timelines for rehabilitation. Companies leave, and the land stays damaged. No one checks if they follow through” (Participant 5).

“Corruption is a big challenge. Officials either turn a blind eye or are too under-resourced to monitor the mines properly” (Participant 7).

“We need stricter penalties for companies that don’t comply. Right now, the fines are too light to make a difference” (Participant 8).

“The government needs to involve the community more. We live here, so we understand the problems better” (Participant 6).

Testimonies show structural flaws in existing policies. Enforcement shortfalls indicate a gap between legislation purpose and implementation. Participants like Participant 3 say mining corporations abuse policy gaps, while Participant 7 blames corruption and resource restrictions for enforcement failures. Participant 5 noted that rehabilitation dates are lacking, compounding enforcement issues. Everyone agrees that current deterrents are insufficient; hence, tougher punishments are recommended. Participant 8 agrees that non-compliance sanctions are too light to force corporate responsibility. Participant 6 emphasises community involvement, emphasising the disempowerment of people most affected by unrehabilitated mines. Policy solutions may not reflect local circumstances without local input.

The findings support literature criticising the South African mining policy framework for enforcement issues and community disintegration. While policies outline sustainable development goals, implementation gaps allow mining firms to avoid responsibility, especially after closure, according to Sibanda (2021). Nwaila (2021) notes that rehabilitation plans fail to hold firms accountable due to a lack of clear expectations and enforcement mechanisms.

Cole and Broadhurst (2022) suggest that sustainable development in mining areas involves local voice in policymaking, as does Participant 6. The literature supports participants' worries about insufficient sanctions. Kuipa (2023) suggests obligatory rehabilitation money before mining operations begin to address compliance difficulties. The evidence contradicts Chanda-Kapata (2020), which claims recent policy changes have improved. Participants' lived experiences show that these reforms have yet to affect the community, emphasising the need for policy enforcement and transparency.

Policy and practice differ due to global mining governance trends. Resource-rich regions have enforcement issues and little funding, according to Marais et al. (2024). Klerksdorp

shows how systemic difficulties emerge locally, with serious environmental and socio-economic consequences.

4.4.4 Research Question: d) How do the practices and outcomes of the mining sector in Klerksdorp align or misalign with the Sustainable Development Goals (SDGs)?

The semi-structured interview replies showed that Klerksdorp mining operations do not support the Sustainable Development Goals. Most participants noted that mining firms have failed to promote environmental sustainability, economic development, and community well-being. Participants mentioned air and water pollution, public health decline, and inadequate rehabilitation. Communities near unrehabilitated mines, especially informal settlements, experienced the worst effects, including increased respiratory ailments and limited clean water availability.

Some participants highlighted occasional attempts, like tree planting or fencing off hazardous areas, but they were superficial and unsuccessful in addressing the long-term environmental and socio-economic issues caused by unrehabilitated mines. The interviews focused on the lack of transparency and community involvement in sustainability planning and implementation. These findings show a major misalignment with SDGs 3 (Good Health and Well-being), 6 (Clean Water and Sanitation), and 15 (Life on Land).

Responses from Participants

"Honestly, mining companies here don't seem to care about sustainability. They do the bare minimum, like planting some grass, but the real problems, like water pollution, remain unsolved." (Participant 2)

"We've seen no real progress on SDG goals like clean water. Streams near the mines are contaminated, and the dust storms just keep coming. People are suffering." (Participant 5)

"The dust and air quality issues are terrible, especially for childrens. My daughter developed asthma, and the doctors say it's linked to the pollution from the mines." (Participant 6)

"We don't feel included in any plans the mining companies make. It's as if they decide for us without asking what the community really needs." (Participant 3)

Participants' qualitative data shows mining operations' ignorance of sustainability aims. Most participants said mining-related water contamination substantially affected SDG 6 (Clean Water and Sanitation). They complained about mining corporations' reluctance to employ water management measures like improved filtration systems or tailings disposal. SDG 3 (Good Health and Well-being) became another priority. Participants often mentioned the health risks of mine-related contaminants, such as chemical-laden dust. The frequency of respiratory diseases, especially in youngsters, indicates a health crisis from unrehabilitated mines.

Participants noted SDG 15 (Life on Land) progress was lacking. Sporadically planting trees was regarded as a token gesture, failing to solve the ecological devastation caused by decades of mining.

These findings support mining communities' SDG misalignment difficulties when compared to existing literature. Many South African mining firms prioritise superficial environmental rehabilitation above long-term rehabilitation, according to Sibanda (2021). Cole and Broadhurst (2021) also found that many mining corporations ignore environmental and health-related SDGs in their operational frameworks. Kuipa (2023) disagrees, arguing that community engagement and open monitoring methods can improve SDG alignment in mining activities. This disparity shows how good governance and participative frameworks can help mining operations promote sustainable development. The data's repeating themes match Nwaila's (2021) analysis of abandoned mines' socio-economic and environmental repercussions, which emphasise vulnerable populations' disproportionate cost. This study agrees with participants that informal settlements suffer disproportionately due to proximity to unrehabilitated sites and lack of means to offset the effects.

4.4.5 Research Question: e) What is the degree of integration between the IDP and social labour strategies of mining companies

Data on this issue showed that mining corporations' social labour strategies and the Integrated Development Plan were not aligned. Participants stressed that most enterprises seemed to operate independently of municipal development agendas, making these efforts fragmented. Several participants noted that while the IDP sets long-term development goals for the region, mining corporations prioritise short-term, independent efforts that do not satisfy the community's socio-economic requirements.

Poor stakeholder communication, lack of transparency in strategy implementation, and lack of accountability in completing commitments were the main interview issues. Participants also observed that lack of community engagement has resulted in initiatives that do not match local priorities. One attendee noted that while some firms donate to schools or clinics, these contributions are reactive and fail to address fundamental concerns like unemployment and housing shortages.

Response Quotes

"It's like they're doing their own thing. The companies' strategies and the IDP goals… they just don't match up." (Participant 3)

"We've had meetings about the IDP, but there's no follow-up. The mining companies say they'll help, but nothing ever happens." (Participant 7)

"The projects they start don't last. They're small and don't address the real issues, like jobs or housing." (Participant 2)

"There's a lack of communication between the companies and the municipality. No one's on the same page." (Participant 6)

The extracts reveal that mining businesses' social labour programs rarely meet IDP goals. Companies claim development objective alignment, but participant insights suggest strategic integration is lacking. Short-term projects show that mining firms value visibility above impact in corporate social responsibility. Poor communication hinders teamwork and stakeholder trust, making it a major concern. Limited commitment follow-through has weakened community confidence, making residents doubt such alliances. This fits with the notion that mining businesses generally prioritise regulatory compliance over real progress.

Comparing Klerksdorp's IDP and social labour integration with current literature shows a pattern across South Africa's mining areas. Sibanda (2021) shares participants' concerns about short-termism by criticising mining corporations' focus on corporate image over growth. Cole and Broadhurst (2020) suggest that effective integration requires persistent collaboration and transparency, which Klerksdorp lacks.

Some research suggests improvements. According to Kuipa (2023), locals should design and oversee development programs. This technique supports IDP goals and

accountability. This kind of integration requires robust enforcement mechanisms and openness, which the existing system lacks, according to Nwaila (2021).

4.5 Discussion of the Findings

The study's results are very important since they show how unrehabilitated mines affect communities in Klerksdorp in many ways, including health effects, environmental dangers, and problems with the economy. One theme that keeps coming up is how the effects are unfairly felt by disadvantaged groups living in informal areas. This shows how important it is to have rehabilitation plans that include everyone and last.

4.5.1 Environmental Hazards and Community Health

Klerksdorp has water, air, and soil pollution. Residents found discolored, chemical-smelling water from abandoned mines. Dust pollution, especially in windy seasons, causes asthma and coughing in many. Since informal settlements near mines lack resources to minimize exposure, these threats disproportionately damage them (Cole and Broadhurst, 2020; Kuipa, 2023).

Laker (2023) revealed that abandoned South African mining sites fail to solve long-term environmental issues, leaving populations contaminated. Dust suppression methods like occasional spraying and tree planting do not address soil instability's origins, according to Kuipa (2023). Mhlongo (2023) states that mine tailings water contamination exacerbate health disparities in mining zones since community people use boreholes. These findings demonstrate that present cleanup efforts are unproductive and unsustainable, requiring a community-driven environmental management strategy.

4.5.2 Socioeconomic Impacts of Mine Closures

When mines in Klerksdorp close, they have big social and economic effects, like causing a lot of people to lose their jobs and making living conditions worse. People who took part in the discussion stressed that mining companies used to be the main employers and economic drivers in the area, giving steady income and supporting local businesses. Since they closed, family income went down, businesses went out of business, and people spent less, which led to a regional economic slowdown (Dzimiri, 2024; Makgetla et al., 2019). Many small businesses depended on the buying power of mineworkers, and they have been hit hard. This has left towns without other ways to make money.

People who took part also said that the economic fallout put a lot of stress on public schooling and health care systems. Healthcare costs are very high for low-income families, especially those living in informal areas. As a result, many of them have to use public clinics that are overcrowded and don't have enough money. Illnesses related to mining, like silicosis and tuberculosis, make this stress even worse. Nwaila (2021) says that these conditions affect a lot of former miners and their families, but it's still hard for them to get specialized care. Participants pointed out that there aren't any specific programs to deal with these health problems, which makes the people who are affected even more vulnerable.

Participants also saw that childrens whose families depend on mine are more likely to drop out of school since they can't afford it. This fits with Nwaila's (2021) research that mine closures in South Africa make it harder for people to go to school and do well in school, which keeps them in poverty. People said that the current ways of helping, like retraining programs and food parcels, are not enough and can't last. Marais et al. (2024) say that these actions don't deal with the real reasons behind economic insecurity, like the lack of diverse job opportunities and long-term plans for community development.

The social and economic problem in Klerksdorp is made worse by the fact that people who get sick from mining are not getting treatment. People who used to work in mines often get diseases like silicosis and tuberculosis, which need specialized and long-term care that isn't always available in public hospitals. This lack of care highlights a bigger problem with the way mine closures are planned: health issues are often left out of the planning process. To solve these problems, the government, mining companies, and regular people all need to work together. A complete plan that includes economic diversification, easy access to health care, and focused educational support can help lessen the negative social and economic effects of closing mines, making communities stronger and more stable after mining.

4.5.3 Rehabilitation Efforts by Mining Entities

Mining companies' rehabilitation is inadequate. The environment has suffered from fencing risky areas and sporadic tree planting. Many restoration efforts failed due to lack of long-term planning and sustainability (Kuipa, 2023; Cole et al., 2024).

The lack of remedy matches Nene (2019), who highlighted inadequacies in South African mine closure statutory financial provisions. Reforestation, soil stabilisation, and water filtration are recommended by Mills (2022) for recovery, although Klerksdorp has not done so. This negligence reveals that mining companies prioritize cost cutting over environmental restoration, leaving communities to bear the ecological damage.

4.5.4 Policy and Governance Challenges

Most of the people who took part said that the current strategies for closing down mines and promoting sustainable development were not good enough. Companies that mine avoid rehabilitation since punishments and regulation are not strict enough. This criticism backs up what Cornelissen et al. (2019) said about how corruption and limited resources make it hard to implement policies in South Africa's mining industry.

Recovery groups don't have deadlines or accountability, which makes the problem worse. Kuipa (2023) suggests that mining companies should be required to set aside money in a trust fund for restoration costs before they start working. This plan could fill in the holes in how policies are enforced and speed up rehabilitation. Policy making and implementation need close oversight and feedback from the community.

4.5.5 Alignment with Sustainable Development Goals (SDGs)

Klerksdorp's mining operations and aftermath contradict the UN Sustainable Development Goals (SDGs) for clean water and sanitation (SDG 6), excellent health and well-being (SDG 3), and sustainable cities and communities (SDG 11). Participants noted that unrehabilitated mines pollute water and air, violating these global goals. Cole and Broadhurst (2021) note that such tactics harm mining communities' health and resiliency as well as the environment. Further, Measham et al. (2024) suggest that abandoned mines without proper rehabilitation demonstrate a systemic failure to match local operations with global sustainability standards.

Some mining companies have tried to connect with SDG 8 (Decent Work and Economic Growth) by generating alternative jobs, although mine closures have had a negative impact on the economy. Participants emphasized that unemployment, consumer spending cuts, and local company failures have slowed progress toward this aim. To connect with SDGs, Chanda-Kapata (2020) suggests mining enterprises invest in long-term infrastructure, healthcare, and education. These practices are fragmented and ineffectual in Klerksdorp due to poor planning and execution.

Multiple stakeholders are ultimately responsible for SDG alignment. Government regulation must implement strict environmental and socio-economic rehabilitation programs to keep mining companies accountable. Mining corporations, the main contributors, must pay and undertake sustainable closure and restoration initiatives. Local communities must also advocate for transparency and integrate their demands into development plans. These stakeholders must collaborate more in Klerksdorp to close gaps and promote equitable, sustainable development in line with the SDGs. Without responsibility and collective action, the region faces environmental and socio-economic imbalances, leaving populations exposed to further degradation.

4.5.6 Community Engagement and the Role of Integrated Development Plans (IDPs)

Mining corporations' social labor policies barely affect municipal IDPs. Poor communication and cooperation between mining companies, local governments, and affected people. Mining has struggled to satisfy social and economic development goals due to this mismatch (Dzimiri, 2024; Marais et al., 2024).

Edwards and Maritz (2019) suggest multi-stakeholder forums for communities to express their integration goals. It would ensure social labor programs cover housing, infrastructure, and unemployment. Without cooperation, IDPs cannot thrive.

4.6 Conclusion

This chapter talks about how mine closures and abandoned mine sites have had big impacts on the Klerksdorp community, focused on how they have hurt the environment, made the economy unstable, and shown that policies don't work. The results make it clear how these problems are linked and how hard things are for people who are harmed. This chapter gives a thorough look at these important problems by using participant observations and an analysis of academic and policy writings.

Pollution of the air, water, and land became the most important environmental problems. Communities that are close to mines that haven't been fixed up are especially at risk since the natural effects make health risks worse and living conditions worse. The opinions of local stakeholders are in line with what Laker and Mhlongo (2023) found, which is that mining has a terrible effect on the environment. However, this study found that rehabilitation attempts were not always carried out properly, and few effective treatments were used. These results make it clear that current rules aren't working well enough and that stricter policing is needed right away to protect the environment.

Closing mines has also caused many people to lose their jobs, the economy to stagnate, and the quality of life in the area to get worse. Like Nwaila (2021), the participants talked about how small businesses were going out of business and how there were no other job prospects. Some parties wanted the economy to become more diverse, while others said that community-led skills training and entrepreneurship needed more money. These different points of view show how hard it is to get mining-dependent areas' economies back on track. This highlights the need for custom, long-term solutions that put sustainable development first.

Problems with policy and government make it even harder to lessen the effects of mine closures. South Africa's Mineral and Petroleum Resources Development Act is a strong set of laws, but it is not always followed, which makes people less accountable. Kuipa (2023) and Mpanza et al. (2021) both say that the government and mining companies don't do enough to be open and honest. To fix these problems and make things more fair, we need to strengthen legislative reform, encourage community input, and make the penalties for not following the rules harsher.

In the end, Chapter 4 looks at the environmental, social, and policy effects of Klerksdorp mine closures and abandoned mine areas that have not been fixed up. The results show how important it is for multiple stakeholders to work together to create long-lasting and reliable answers. By putting these ideas into the context of the Sustainable Development Goals, this chapter makes it possible for suggestions that can be put into action to make policy and practice better.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The report addressed environmental, socioeconomic, and governance issues caused by Klerksdorp mine closures and unrehabilitated mines. Based on research questions, this chapter synthesizes empirical data and literature review findings to provide practical suggestions. Air and water pollution from unrehabilitated mining sites causes public health crises and economic stagnation, the investigation showed. Mine closures have slashed jobs and local economies, worsening poverty.

The study found enforcement and accountability issues notwithstanding mine rehabilitation and sustainable development policies. Mining companies rarely involve communities or address long-term environmental and social repercussions after closure. In theory, South Africa's mining policies complement global sustainability goals, particularly the UN Sustainable Development Goals (SDGs), although they are poorly implemented.

This chapter summarizes data, draws theoretical and empirical implications, and recommends stakeholder strategies. These ideas emphasise strong policy frameworks, community engagement, and innovative, sustainable restoration. To reduce mining impacts and maximize sustainable development in Klerksdorp and beyond, this chapter emphasizes a multi-stakeholder strategy.

5.2 Summary of Findings

5.2.1 Findings from the Literature Review

As an example, South Africa is used in the literature review to show how hard it is to keep post-mining settings in good shape. A lot of studies (Cole & Broadhurst, 2020; Kuipa, 2023) show that mines that have not been fixed up are very bad for the environment. Communities that are close to abandoned mines are more likely to be affected by waste, air pollution, and contaminated water. Public health is especially at risk since ecological system decline is linked to more respiratory and water-borne diseases (Laker, 2023; Nene, 2019). These results were very helpful in creating the interview questions, which looked into how people in the community deal with environmental dangers, their effects on society and the economy, and ineffective government. The questions were also designed to be in line with the main ideas found in the literature.

When mines close, the local economy suffers a lot, with people losing their jobs and businesses going out of business. The abrupt cessation of mining activities in resource-dependent regions causes economic shocks, reducing family incomes and stifling small-business growth (Marais et al., 2024). Sibanda (2021) agrees that mining towns like Klerksdorp are especially sensitive to social and economic problems since they don't have any other industries that can provide jobs. This literature helped me come up with interview questions about the social and economic effects of closing mines. I wanted to find out how people in the community felt about unemployment, less spending by consumers, and the need to diversify the economy.

Problems with governance became a main theme in the writing. While the Mineral and Petroleum Resources Development Act (MPRDA) requires funds for mine rehabilitation, it is not always followed (Kuipa, 2023; De Koker, 2020). Monitoring and openness problems let mining companies get away with their crimes, leaving communities to deal with the long-term effects (Cornelissen et al., 2019). Participants in the study also said that rehabilitation plans were not good enough and asked whether the government and mining companies were responsible. Mhlongo (2023) criticizes South Africa's National Environmental Management Act (NEMA) for not fully incorporating sustainable development principles into mining policy. This shows the need for comprehensive governance changes to handle the difficulties of mine closures.

The review also talks about how hard it is to make mining methods match up with the Sustainable Development Goals (SDGs) of the United Nations. Mining companies often say that short-term job creation helps reach SDG 8 (Decent Work and Economic Growth), but these efforts don't last and don't make up for the environmental and social damage that unrehabilitated mines cause (Cole & Broadhurst, 2021). SDG 6 (Clean Water and Sanitation) and SDG 11 (Sustainable Cities and Communities) are still not being met since of problems with water pollution and poor community development. These gaps shaped the study's main ideas and the interview questions that were used to find out how people in Klerksdorp felt about sustainability and who was responsible for what in the community.

The results also show that there is a big hole in the research when it comes to the views of important groups like labor unions and organized business. These groups are very important for pushing for policy changes and community well-being, but they are not at all present in conversations about closing mines and rebuilding communities. Even though the study's findings are true for most abandoned mining towns, they show how important it

is to include more views when trying to solve the social, economic, and environmental problems that these communities face.

In conclusion, the literature review not only gave the study a theoretical base, but it also directly influenced how the interview questions and conceptual framework were made. By using these ideas, the study hopes to make sure that its results are in line with its goals and that it addresses the complex problems that come with mines that have not been fixed up. In the future, researchers should include the views of labor groups and organized businesses. This will allow for a more thorough and inclusive study of the problems that come after mining.

5.2.2 Findings from the Empirical Study

The literature and empirical study show that unrehabilitated mines in Klerksdorp offer significant environmental, socio-economic, and governance issues. Dust storms and water poisoning were the top environmental concerns. Cole and Broadhurst (2020) stated that respondents often saw discolored streams and metallic-tasting borehole water. These conditions have increased respiratory infections and other pollution-related health issues, emphasizing the need for environmental action.

Mine closures also had serious socioeconomic effects. Participants blamed rampant unemployment on the end of mining, which employed thousands of citizens. Small enterprises, especially mining-related ones, have collapsed, worsening poverty and underdevelopment. Dzimiri (2024) agrees that mining-dependent communities are subject to economic stagnation due to a lack of economic diversification. The findings show that alternative livelihood options and community-driven efforts are needed to revitalize local economies.

Participants also characterized mining companies' rehabilitation efforts as ineffective. Fencing hazardous areas and planting vegetation were the most apparent initiatives, but they were seen as shallow and poorly maintained. Such approaches ignore soil and groundwater contamination, according to Nwaila (2021). Rehabilitation projects are undermined by these inadequacies, which expose communities to environmental and health concerns.

concerns were aggravated by governance concerns. Participants cited insufficient rehabilitation enforcement and corporate secrecy as main post-mining development hurdles. Another major issue was community exclusion from decision-making. To promote

equitable and sustainable post-mining outcomes, Marais et al. (2024) stress inclusive governance systems. Lack of such frameworks has perpetuated environmental deterioration and socio-economic instability in Klerksdorp.

Additionally, the analysis found insufficient compatibility with the UN Sustainable Development Goals. Disused mines violate SDG 3 (Good Health and Well-being) and SDG 6 (Clean Water and Sanitation) since to their environmental and health consequences. Mining corporations' social labor practices did not match local Integrated Development Plans (IDPs), indicating coordination and sustainability planning issues. These findings highlight the need for stronger SDG integration into local and business plans.

5.3 Conclusions of the Study

The study looked at how mine closures and mines that haven't been fixed up have affected the environment, society, and government in Klerksdorp. Pollution from dust and water has hurt people, especially those who live in fragile informal settlements. These risks hurt people's health and hurt the environment in the area, pushing it to the sidelines.

Mine closures have caused a lot of people to lose their jobs, the economy to crash in some areas, and problems with public services. Without viable alternative industries, communities rely on short-term aid, which does not relieve poverty. Abandoned properties' poor rehabilitation increases health risks. Government difficulties, including rehabilitation policy enforcement and community participation, inhibited progress. The uneven and underfunded MPRDA and NEMA provide a foundation for resolving these concerns. The research found that mining corporations' social labour policies don't match local IDPs, hindering growth.

Klerksdorp mining violates health, water, and sustainable community SDGs. The findings recommend accountability, inclusion, and sustainability in mining governance. The research recommends strong policy enforcement, innovative environmental restoration, and stakeholder participation in mine rehabilitation and community development. The long-term effects of mining must be reduced to build resilient Klerksdorp communities.

5.4 Recommendations of the Study

5.4.1 Strengthening Policy Enforcement Mechanisms

Strengthening policy enforcement mechanisms is critical to mitigating the negative impacts of mine closures and unrehabilitated mines on Klerksdorp communities. South Africa has comprehensive mine rehabilitation legislation, but enforcement loopholes hinder their effectiveness, according to survey participants. According to respondents, insufficient accountability and monitoring allow mining firms to avoid rehabilitation duties, leaving communities to suffer environmental degradation and economic hardship.

The research shows that lack of timescales and regulatory control hinders rehabilitation. Participants stressed that rehabilitation initiatives are often opaque and uncoordinated, increasing community vulnerability. An independent regulatory authority for environmental and social compliance could strengthen accountability and guarantee mining companies achieve their rehabilitation obligations. Participants wanted tighter enforcement procedures suited to affected populations.

Increase penalties and fines for mining corporations that violate rehabilitation standards to deter noncompliance. Several participants proposed employing and training environmental auditors from affected communities to increase compliance monitoring. Local experience and community engagement could improve transparency and stakeholder trust. Respondents also supported legislative reforms that set rehabilitation milestones and prioritize community input.

The study shows that Klerksdorp's environmental deterioration and socio-economic collapse would continue without strong enforcement and community involvement. Addressing these gaps requires practical and enforceable measures to ensure sustainable development for regional mining communities.

5.4.2 Establishing a Rehabilitation Fund

Setting up a special rehabilitation fund, which is paid for by mining companies before they start working, is a responsible way to make sure that cleanup happens after the mine is closed. Such a fund would protect against situations where bankrupt companies don't follow the law, leaving communities to deal with the environmental and economic problems caused by mines that haven't been fixed up (De Koker, 2020). People who took part in this

study were angry that there were not any good financial plans for recovery in Klerksdorp, even though the law required them to.

The Mineral and Petroleum Resources Development Act (MPRDA) in South Africa already requires mining companies to set aside money for repair, but the law is not always followed. Legal obligations need to be paired with real ways to make sure they are met. The results of this study say that the amount of money that should be put into the fund each year should be based on how dangerous the mining operation is to the environment. This kind of plan has worked well in other places, showing that proportional contributions can cover the costs of restoring the environment.

To make things more open and accountable, local governments should handle the distribution of these funds with the help of community partners. Marais et al. (2024) say that including communities in the decision-making process can help make sure that recovery efforts are based on local needs and support long-term growth. People who took part said that this method would not only fix the environment but also help mining companies and the people who live near mines trust each other again.

To make sure that everyone follows the rules, punishments must go along with financial responsibilities. Participants strongly backed enforcing strict penalties and going to court against companies that don't follow through on their promises to fix things. As these steps are taken, the fines for partial compliance should get worse, and mining licenses should be taken away from people who don't follow the rules. Improving these systems would make people less likely to be careless and make following through on their environmental and social duties seem more important.

In conclusion, Klerksdorp needs a restoration fund to make sure that the area is properly cleaned up after mining. But for it to work, it needs to be strictly enforced, managed openly, and have harsh penalties for people who only partially follow the rules or don't follow them at all. These changes would make the current legal frameworks much more effective and encourage the mining business to use environmentally friendly methods.

5.4.3 Incorporating Sustainable Development Goals into Mining Practices

Mining initiatives that contribute to the SDGs could benefit the residents of Klerksdorp in the long run. SDG 3 (Good Health), SDG 6 (Clean Water), and SDG 15 (Life on Land) should be at the top of mining companies' plans to get back on their feet (Cole and Broadhurst, 2021). Treating the water and growing new trees would help restore ecological

balance and stop environmental damage (Nwaila, 2021). To ensure sustainable growth, these steps should be part of mining companies' CSR plans.

5.4.4 Enhancing Community Engagement

Effective mine rehabilitation requires community involvement. Klerksdorp communities face environmental risks but are rarely involved in decision-making (Dzimiri, 2024). Residents can vent and help rehab at community consultation forums. Local labour for rehabilitation projects reduces unemployment and boosts community ownership (Sibanda, 2021). Workshops and training can help community members participate effectively.

5.4.5 Investing in Alternative Livelihood Programs

Jobs disappear and host communities languish after mine closures. Mining companies could reduce these consequences by supporting vocational training and entrepreneurship (Makgetla et al., 2019). These projects would be more effective if tailored to local agriculture or renewable energy. Local government and NGO cooperation may help these inclusive, sustainable projects (Mhlongo, 2023).

5.4.6 Improving the Integration of IDP and Social Labour Strategies

Klerksdorp problems arise when Integrated Development Plans (IDPs) do not fit mining companies' social labour practices (City of Matlosana, 2011). Mining companies should align their CSR with IDP goals and commit to long-term community development. Mining corporations, local governments, and community groups should meet often to promote collaboration and integrated strategy execution (South African Cities Network, 2015). Additionally, joint monitoring groups may provide openness and oversight.

5.5 Limitations of the Study

5.5.1 Limited Scope of Data Collection

This study was constrained by qualitative semi-structured interview data. It gave in-depth insights into Klerksdorp villagers' perceptions, but it lacked quantitative data to generalise (McCusker and Gunaydin, 2015). Lack of pollutant levels or economic metrics made environmental and social impacts difficult to analyse.

5.5.2 Restricted Geographic Focus

The study neglected adjacent regions with similar problems since it focused on Klerksdorp. This narrow focus delved into local issues but limited applicability to other South African

mining locations (Cole and Broadhurst, 2020). Comparative insights and mine closure consequences may have been gained by expanding geographically.

5.5.3 Limited Policy and Stakeholder Analysis

The study examined the mine rehabilitation policy framework, not local government and mining company tasks. This lack prohibited the inquiry from discovering systemic issues like overlapping responsibilities or accountability gaps (Cornelissen et al., 2019). A more thorough stakeholder study may have improved proposals.

5.5.4 Potential Bias in Interview Responses

Another limitation is interviewee bias. Those with severe mining company grievances may overestimate mine closures' negative effects (Kumar, 2019). Mining workers may have downplayed these impacts. Integrating various people lessened bias, although biassed opinions remain.

5.5.5 Constraints in Historical Data Access

Mine closure and rehabilitation data are scarce therefore; the study could not examine long-term trends. Anecdotes and secondary sources may not reflect the issue's complexity (De Koker, 2020). This gap may have been filled by extensive archival research on the historical context.

5.6 Suggestions for Future Studies

5.6.1 Quantitative Assessment of Environmental Impacts

Mining closures should be studied using quantitative approaches including water and air quality measurements. This would enhance the qualitative findings of this study and help Klerksdorp residents comprehend their environmental issues (Mpanza et al., 2021). Rehabilitation success may be revealed by longitudinal environmental studies.

5.6.2 Comparative Analysis across Mining Regions

The generalisability of findings could be improved by including multiple South African mining districts. Comparative analysis could show geographical differences in mine closure effects and policy efficacy (Cole et al., 2024). This method may also reveal optimal practices that can be imitated.

5.6.3 Economic Impact Studies

Mine closures' economic effects on host towns need more research. Future study could compare unemployment, household income, and local business activity before and after mine closures (Makgetla et al., 2019). These findings could guide targeted economic resilience programs in affected areas.

5.6.4 Evaluation of Policy Effectiveness

Future research should assess South Africa's mine rehabilitation policy framework's enforcement and results. Case studies of successful restoration projects may reveal best practises (Nwaila, 2021). Corruption and governance research in policy execution may offer reforms.

5.6.5 Role of Technology in Rehabilitation

Drones and GIS enable mine rehabilitation monitoring and management. Research might evaluate how these technologies increase rehabilitation transparency, efficiency, and accountability (Mhlongo, 2023).

5.7 Final Remarks

Mine closures and unrehabilitated sites in Klerksdorp offer major environmental and social challenges, according to this report. Policies help sustainable development, but enforcement and accountability restrict their effectiveness. These concerns require stricter policy enforcement, community participation, and alternative livelihood investment. Sustainable development goals and stakeholder engagement can mitigate mining consequences and strengthen communities. Mining should benefit future generations, not burden them, hence more research and innovation are needed.

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ANNEXURE A: INFORMED CONSENT LETTER

NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520
http://commerce.nwu.ac.za/business-school

13 August 2024

Participant code: _____

DEAR PARTICIPANT

INFORMED CONSENT LETTER TO INTERVIEW PARTICIPANTS

You are invited to take part in a research study that forms part of a Master of Business Administration (MBA) degree. Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you might be involved. Also, your participation is entirely voluntary, and you are free to say no to participating. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part now.

The culmination of this study will result in the development of a mini-dissertation, which forms a mandatory part of the requirements for the successful completion of my Master's in Business Administration degree. The NWU is an esteemed and internationally accredited institution with a strong commitment to ethical research standards and practices. Please be informed that this research adheres with the requirements of the Protection of Personal Information Act (Act 4 of 2013) (POPIA) and your non-identifiable responses will be stored in a password-protected file on a cloud drive. The POPI Act ensures that your personal information is treated with the utmost care and that your rights to privacy are upheld.

This study has been approved by the NWU Economic and Management Sciences Research Ethics Committee (EMS-REC) and will be conducted according to the ethical guidelines and principles of the North-West University and other international ethical guidelines applicable to this study.

Title of the project:
The impact of mine closures and unrehabilitated mines on the surrounding Klerksdorp communities
Institution: NWU Business School
Ethics Reference Number: NWU-01776-24-A4

Names and contact details of project staff

	Supervisor	Researcher
Title, name & surname	Prof Ronnie Lotriet	Mr. Kagiso Maruping
Full Names	Ronnie	Kagiso Robert
Function in Project	Principle Investigator	Researcher
Telephone	018 299 1414	072 647 4673

What is this research study all about?

The primary objective of the research is to investigate the immediate and long-term environmental impacts of mine closures and unrehabilitated mines in the Klerksdorp region.

Why have you been invited to participate?

You have been invited to participate in this research study because you fall into at least one of the following categories:

- Local Government, City of Matlosana Planning and Development Office
- Part of an active mining houses, Harmony Gold, Village Main Reef and CAPM
- Department of Mineral Resources and Energy (DMRE)
- Community and Business Forums around Klerksdorp area
- Economic Development Consultants around Klerksdorp area

What will be expected of you?

You will be expected to:

- Participate in a 45 – 60min semi-structured interview with the researcher at a suitable time and private area without interruptions that is convenient for both parties, this will be done face to face or via an online platform. This will be scheduled by the researcher once approved by the NWU ethics committee.
- Respond to the questions in an open and honest manner.
- The interviewer will be taking notes for the purpose of data analysis.
- These notes will be transcribed and stored on a password-protected computer to ensure confidentiality.
- Both transcripts and recordings will be securely deleted after three years.
- Inform the supervisor should you feel or experience any form of discomfort or distress during the research process and inform the supervisor if you at times feel the need to terminate your involvement in the research process.

Will you gain anything from taking part in this research?

This research study intends to give you a voice to reveal, explain and reflect on the impact that mine closure and unrehabilitated mines have on the surrounding communities. No monetary reward will be made available for participation in the study.

Are there risks involved in your taking part in this research and what will be done to prevent them?

Participation in this study does not create any physical risk to you as the study does not involve any physical activities or experiments. We, however, have identified certain ethical principles that shall be always maintained to prevent any damage to you. The focus of these principles will be to protect your dignity and keep all records provided private and confidential.

How will we protect your confidentiality and who will see your findings?

You will be assigned a unique participant ID. Our interview will be recorded and saved with reference to the ID, but data collected shall be regarded as confidential and will not be shared with any 3rd party that is not directly involved in the research process. Personal details of participants and their direct input to the research study shall not be made public. All records of the research shall be kept for a retention period and destroyed by an appropriate means. The findings of the study will be made public however will not contain any raw data that might incriminate certain individuals.

What will happen with the findings or samples?

The findings concluded in the study will be for academic purposes and will only be utilized to add to the current body of available knowledge. The findings may be published in academic journals, presented at conferences, or used in other scholarly and educational settings. If published, the

information will be presented in a way that ensures the anonymity and confidentiality of all participants. No personal identifying information will be disclosed.

How will you know about the results of this research?
Participants in the study, should they require, will be made aware of the results of the research, through a two-page communique, by means of electronic mail. The electronic final version of the dissertation will also be made available if requested.

Will you be paid to take part in this study and are there any costs for you?
Participation in this study will not yield monetary value to you. There is no cost envisaged to you except the time that you spend participating in this study. This study will be funded by the researcher himself.

Is there anything else that you should know or do?
You may contact the supervisor, Prof Ronnie Lotriet, on 018 299 1414 or Ronnie.lotriet@nwu.ac.za if you have any further questions or problems. You will receive a copy of this information and consent form for your own purposes.

DECLARATION

Declaration by participant

By signing below, I (PARTICIPANT ID) agree to take part in the research study titled: The impact that mine closure and unrehabilitated mines have on the surrounding Klerksdorp communities.

I declare that:

I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable in. The research was clearly explained to me. I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered. I understand that taking part in this study is voluntary and I have not been pressured to take part. I may choose to leave the study at any time and will not be handled in a negative way if I do so. I may be asked to leave the study before it has finished if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Please tick the box below to indicate your consent:

☐ I agree to participate in this research study and consent to being interviewed.

Signed at: _____ On: _____

Signature of participant Signature of witness

_____ _____

Declaration by researcher

I Kagiso Maruping declare that:

- I explained the information in this document to (PARTICIPANT ID)
- I did/did not use an interpreter
- I encouraged them to ask questions and took adequate time to answer them or I was available should they want to ask any further questions.
- I am satisfied that they adequately understand all aspects of the research, as described above.
- I am satisfied that they had time to discuss it with others if they wished to do so.

Signed at: _____ On: _____

Signature of researcher Signature of supervisor

_____ _____

ANNEXURE B: INTERVIEW SCHEDULE

NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520
http://commerce.nwu.ac.za/business-school

INTERVIEW SCHEDULE

My name is Kagiso Maruping and I am a Master of Business Administration (MBA) student at the North-West University Business School. This interview seeks to gain some further insight into the impact of mine closure and unrehabilitated mines. Specifically, this study aims to **explore**

(title): The impact that mine closure and unrehabilitated mines have on the surrounding Klerksdorp communities

Thank you for agreeing to the interview and the estimated duration will be 45 minutes. Your contribution to the study is highly appreciated. Furthermore, your contribution will assist in developing themes associated with the subject. You should note that your consent may be withdrawn at any time should you no longer wish to participate in the interview. The study complies with the requirements of the Protection of Personal Information Act (Act 4 of 2013) (POPIA) and your non-identifiable responses will be stored in a password-protected file on a cloud drive.

With that being established, I want us to have a relaxed conversation. Please get comfortable and feel free to express yourself however you wish. Firstly, I would like to establish your demographic information as this will help me describe and create a profile for participants. Demographic data allows researchers to better understand the characteristics of the study's participants. This understanding is critical for interpreting the findings in the context of the particular group examined. **Note that the purpose of the demographical information is to profile the participants and will not be used for further statistical analysis or comparisons.**

Demographic identifiers:

1. What gender do you identify yourself as?
2. How old are you?
3. What is your highest level of academic qualification?
4. What is your current occupation?
5. How long have you lived in the Matlosana area?
6. Have you or any member of your household ever been employed in the mining industry?
7. Do you consider yourself or your household to be affected by mine closures in the area? If yes, in what ways?

NWU BUSINESS SCHOOL

NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520
http://commerce.nwu.ac.za/business-school

Thank you for providing such vital information. From here on, I will be asking mining-related specific questions.

1. What are the predominant environmental hazards associated with unrehabilitated mines in Klerksdorp?

2. How have mine closures affected employment, economic stability, and well-being in the host communities?

3. What measures have been implemented by mining entities for post-operational site rehabilitation? Are they sufficient and sustainable?

4. Does the current policy framework encourage sustainable development, or does it require modification?

5. How do the practices and outcomes of the mining sector in Klerksdorp align or misalign with the Sustainable Development Goals (SDGs)?

6. What is the degree of integration between the IDP and social labour strategies of mining companies?

Thank you for your time and patience.

Your contribution is appreciated, and the study results will be available at your convenience.

ANNEXURE C: PERMISSION LETTER FROM DMRE

mineral resources
& energy
Department:
Mineral Resources and Energy
REPUBLIC OF SOUTH AFRICA

Private Bag A1, Klerksdorp, 2570, Tel: (018) 487 4362, Fax: (018) 462 9036
Vaal University of Technology Building, Cnr Margareth Prinsloo & Voortrekker Street, Klerksdorp, 2570

15th May 2024

NWU Business School

North-West University

Private Bag x6001

Potchefstroom, 2520

Attention: To whom it may concern

Permission Letter to conduct research using DMRE data

This letter serves to confirm that Kagiso Maruping under supervision of Prof Ronnie Lotriet may conduct academic research on the premises of Department Mineral Resources and Energy and may make use of the company data, as specified below. Furthermore, the data generated during the research may be used to compile the mini-dissertation.

Department Mineral Resources and Energy hereby commits to providing the necessary research support in the form of policies, guidelines and data.

1. The researcher may make use of the following data:
   - All the data relevant to the topic or subject of his research
2. The data may be used on the following conditions:
   - Only for the purpose of the academic research and not anything else
3. The researcher may access the following areas within the organisation, while adhering to the state rules/guidelines:
   - Offices – only with prior arrangement with the person that the meeting will be with
4. In terms of Department Mineral Resources and Energy safety policies, the researcher need to take cognisance of the following applicable matters/rules/policies/induction training:
   - Confidential information
   - Not to mention officials names

mineral resources
& energy
Department:
Mineral Resources and Energy
REPUBLIC OF SOUTH AFRICA

Private Bag A1, Klerksdorp, 2570, Tel: (018) 487 4362, Fax: (018) 462 9036
Vaal University of Technology Building, Cnr Margareth Prinsloo & Voortrekker Street, Klerksdorp, 2570

Yours sincerely

Jose Malembe

Principal Inspector of Mines – NW Klerksdorp

018 487 4300

ANNEXURE D: ETHICS APPROVAL LETTER OF STUDY

Private Bag X1290, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Fax: 018 299-4910
Web: http://www.nwu.ac.za

Senate Committee for Research Ethics
Tel: 018 299-484
Feziwe.Mseleni@nwu.ac.za

21 October 2024

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Economic and Management Sciences Research Ethics Committee (EMS-REC)** on, **21/10/2024** the Economic and Management Sciences Research Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-REC) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: The impact that mine closure and unrehabilitated mines have on the surrounding Klerksdorp communities

Study Leader/Supervisor (Principal Investigator)/Researcher): Prof. R. Lotriet
Student: K. Maruping (41459156)

N	W	U	-	0	1	7	7	6	-	2	4	-	A	4
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type:
Commencement date: 21/10/2024 **Risk:** **Minimal Risk**
Expiry date: 21/10/2025
Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

- None.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The study leader/supervisor (principal investigator)/researcher must report in the prescribed format to the EMS-REC:*
  - *annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the EMS-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*

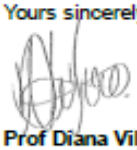
- *Annually a number of studies may be randomly selected for an external audit.*
- *The date of approval indicates the first date that the study may be started.*

n the interest of ethical responsibility, the NWU-SCRE and EMS-REC reserves the right to:

- *request access to any information or data at any time during the course or after completion of the study;*
- *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
- *withdraw or postpone approval if:*
  - *any unethical principles or practices of the study are revealed or suspected;*
  - *it becomes apparent that any relevant information was withheld from the EMS-REC or that information has been false or misrepresented;*
  - *submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or*
  - *new institutional rules, national legislation or international conventions deem it necessary.*

The EMS-REC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the EMS-REC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,



Prof Diana Viljoen-Bezuidenhout
Chairperson: NWU Economic and Management Sciences Research Ethics Committee

Turnitin Report

Mini-Dissertation_Kagiso Maruping.doc

ORIGINALITY REPORT

7%	6%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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2	hdl.handle.net Internet Source	<1%
3	Submitted to Coventry University Student Paper	<1%
4	Submitted to Pathfinder Enterprises Student Paper	<1%
5	Castle, Samantha. "Enabling Leadership of and Innovation in South African Mining Companies: Pursuing Environmental, Social, Governance Principles and the 2030 SDGs.", University of Pretoria (South Africa) Publication	<1%
6	Submitted to University of Wollongong Student Paper	<1%
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