BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SOCIAL SCIENCES AND HUMANITIES

THE ENVIRONMENTAL IMPACTS OF MINING ACTIVITIES IN ZIMBABWE: CASE OF JENA GOLD MINE, KWEKWE.

BY

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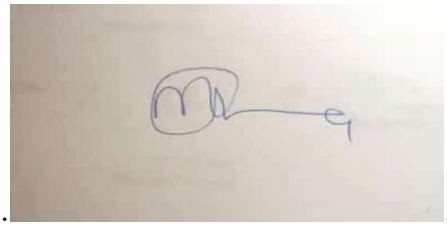
ABSTRACT

The study explored the impacts of Jena gold mining activities in Silobela, focusing on water sources, environmental degradation, and local benefits. A mixed research approach was used in the study, taking a case study of the Silobela community in Kwekwe. Data was collected from 28 community members using questionnaires and from 3 key informants from the Environmental Management Agency (EMA) using interviews. Descriptive statistics, including mean and standard deviation were used to analyse quantitative data. Qualitative data was analysed using thematic analysis. The findings revealed significant concerns about water quality, with mining operations contaminating nearby rivers and underground water with toxic chemicals like mercury and cyanide. Local water shortages were also exacerbated by excessive water consumption by the mine. Regarding environmental impacts, deforestation, wildlife displacement, and increased air pollution were highlighted. Mining activities led to habitat destruction, increased soil erosion, and respiratory problems due to dust and emissions. Despite these challenges, the study found that mining had positively impacted employment and local businesses, providing new job opportunities and stimulating economic growth. However, the community reported limited infrastructure development and inadequate environmental management efforts. The study recommended that policy makers should strengthen environmental regulations and enforce stricter mining regulations including mandatory environmental impact assessments before issuing mining permits and impose penalties for non-compliance. It also recommends that EMA to work with stakeholders to ensure mining companies implement proper water treatment systems and reduce water consumption to prevent shortages in local communities.

Declaration form

I, Merit Chimwaza (B211072B) supervised by Dr Chipaike, hereby declare that this dissertation is the result of my own research and study, except to the extent indicated in the acknowledgments and references included in the body of the paper, and that it has not been submitted in part or in full for any other degree to any other university. The research was done within the boundaries of the research ethics and the ethics of the profession. I also declare that the university can use this dissertation for academic purposes.



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Dedication

This dissertation is dedicated to my late son who died in the early stages of this research. May his pure soul rest in eternal peace.

Acknowledgements

My first acknowledgement goes to my parents Mrs Chimwaza and CDE Chimwaza for seeing me through school and their unwavering support from the beginning of this journey. Thank you so much mama and Baba for pushing me to work hard and for the moral and emotional support. I would also love to thank my sister, my friends for being there with me through this journey encouraging me to work hard and also for assisting me financially to promote the success of this project. To my supervisor, Dr Chipaike, I am really grateful for the honest comments, corrections and guidance offered to make this project successful, also for the quick responses to my submissions, thank you so much because it pushed me to work hard to meet deadlines. I am also indebted to my husband who also gave me his full support to study hard and was understanding during the course of this project because it required most of my time and attention. This research would not have been successful had it not been for my key informants in Kwekwe, Silobela and Environmental Management Agency personnel's who were very participant and provided relevant information for my research. This could not have been possible without God, so all thanks and glory be to God Almighty.

List of Abbreviations and Acronyms

CSR	Corporate social responsibility
EIAs	Environmental impact assessments
EMA	Environmental Management Agency
NGOs	Non-governmental organizations
SPSS	Statistical Package for the Social Sciences
ZMDC	Zimbabwe Mining Development Corporation

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Mining activities have long been a significant contributor to the economy of many nations. However, they pose severe environmental challenges that are detrimental to human beings and the natural ecosystem. Mukwekwezeke et al. (2022) explains that mining operations lead to deforestation, soil erosion, and water pollution, disrupting ecosystems and biodiversity. Toxic emissions and hazardous waste from mining also pose serious health risks to local communities, leading to respiratory diseases and waterborne illnesses (Mkodzongi & Spiegel, 2021). Additionally, mining-induced land degradation threatens livelihoods and fuels social conflicts (Taruvinga et al., 2023). Given these adverse impacts, it is essential to assess the extent of environmental damage and propose sustainable mitigation strategies to balance economic benefits with ecological and societal well-being.

In Zimbabwe, gold mining dates back to the pre-colonial era and has remained one of the major economic activities in the country (Njini, 2018). In recent years, the industry is predominantly conducted by small-scale operators and informal gold panners scattered around the country (Njini, 2018). Recently, the government has recognised the contribution of these people and has advised them to sell their product to Fidelity Printers. Through the Zimbabwe Mining Development Corporation (ZMDC), the government has encouraged small-scale gold mining in different parts of the country (Njini, 2018). Jena mine which is located in Silobela 80km from Kwekwe district is a member of the ZMDC and has caused several environmental challenges.

Hence, there have been incalculable reports of clashes between the Jena mine operators in Kwekwe and the local communities including the Silobela community. The mine, in 2010,

began to run under Kuvimba Mining House which has since invested in revitalizing and expanding operations while leaving large tracks of destruction to the environment. The Zimbabwe Mining Review (2022) clearly articulates that farmers settled around Mupezeni Farm in Silobela are clashing with the Jena artisanal miners, accusing them of rescinding their grazing lands and sources of water due to mining activities. The deadlock commenced around 2001, and farmers are now demanding the removal of the mine, claiming it has led to displacement and resettlement of the local people, deforestation and it has destroyed their livestock water sources. Also, according to the Environmental Management Authority (EMA) some of the artisanal miners have been operating illegally along the Mukwembi River for a while, threatening the live wood of the community residents (African Mining Market, 2020).

In addition, there have been reports of workers at the Jena Mine facing challenges related to pay and working conditions. Some of the issues include Low wages: the artisanal miners at Jena Gold mine have reported being paid below the minimum wage or not receiving fair compensation for their work. They have also reported delayed payments. There have been instances of delayed or overdue payments, causing financial difficulties for workers. In addition, workers have raised concerns about unsafe working conditions, including exposure to harmful chemicals such as cyanide and lack of proper protective equipment, including helmets and gloves.

According to Bhebhe (2008) cyanide, borax, sodium nitrate, hydrochloric acid and lime are the chemicals used in mineral processing. These chemicals are hazardous to the human body. Accidental spillages of those chemicals on skin or inhalation and ingestion of those chemicals results in health problems to the employees (Bhebhe, 2008). Moran (2000) argues that chemical substances for example cyanide which is used as a solvent for metals like gold results in stomach, heart and brain problems as well as death. The frequency of exposure to the dangerous chemicals also indicates the severity of a chemical hazard. There are also mechanical hazards

in the plant area because some workers have to work on raised platforms thereby risking their lives through possible falls from these great heights. In addition to that, conveyor belts pose a danger to workers who handle them accidentally when they are in motion.

Chemical spills on terrestrial lands pose a danger to plant life and animals which are an essential element of the environment (Mapira, 2006). The chemical tailings which at times are left on surfaces, expose the environment to risks. Previous research have revealed how mining operations threaten natural landscapes of the surrounding communities (Mapira, 2006). For example, during the period from 1952 to 1996, the landscape around Buchwa Mine in Mberengwa was so damaged that it disturbed both animal and plant species. Obviously, some animals lost their habitats leading to either migration or extinction (Mapira and Zhou, 2006).

1.2 Purpose of the study

The purpose of this study was to understand the effects of Jena gold mine activities in Kwekwe and suggest solutions to the implications of the mining activities.

1.3 Statement of the problem

According to the Zimbabwe Mining Review (2022) farmers settled around Mupezeni Farm are in conflict with the Jena gold mine, accusing it of destroying their grazing lands and sources of water due to mining activities. The impasse started in 2021 and farmers are now demanding the removal of the mine, claiming it has destroyed their livestock's water sources (Zimbabwe Mining Review, 2022). Hence, this problem is unswervingly affecting Silobela as they are running out of grazing lands and having their water source contaminated by the miners. The Zimbabwe Mining Review (2022) revealed statistics which indicate that since 2014, about 73, 3% of Silobela community residents are directly impacted by mining activities in the area. Hence, this study saved to find out about the impacts of mining operations in the Silobela

community in Kwekwe. The impacts were looked at from the environmental perspective, human rights and health perspective. However, the research was not only confined to the negative impacts of the mining operations, but it also provided insights into the benefits of the mining activities to the local residents.

1.4 Research objectives

i. To evaluate the impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents in the Silobela community.

ii. To examine the implications of Jena gold mining operations to the trees, wild animals and the atmosphere in the Silobela community.

iii. To examine and appreciate the benefits of Jena gold mining activities to the local residents in the Silobela community.

iv. To suggest ideas for the development of policies to protect surrounding communities from the detrimental effects of gold mining in Zimbabwe.

1.5 Research questions

i. What are the negative effects of Jena gold mining activities towards cleaner sources of water in the Silobela community?

ii. How is Jena gold mine affecting the trees, wild animals and the atmosphere in the Silobela community?

iii. What are the benefits of the mining operations to local people in the Silobela community?

iv. What ideas can be suggested for the development of policies to protect surrounding communities from the detrimental effects of gold mining in Zimbabwe?

1.6 Assumptions

The study made use of the following assumptions;

1. The organization is benefiting the community economically by providing job opportunities for the local people.
2. Mining activities on the area are causing environmental degradation.
3. Emitions from the mining processes are also causing water pollution, making the water unsafe to consume for both people and livestock.

1.7 Significance of the study

The study is significant as it generated ideas that lead to the development of policies that protect Kwekwe communities from the negative environmental impacts such as water and land pollution, posed by Jena gold. It also generated ideas that contribute to the evolution of policies that protect the Silobela local peoples' livelihoods. The study would assist the Environmental Management Agency, working hand-in-hand with the Ministry of Mines and Mining Development in ensuring the safety of miners and local people who are directly impacted by the mining activities. The study is also significant to the scholars or academics who would want to engage in further studies of the impacts of mining to the environment and the local people in different areas in Zimbabwe.

1.8 Delimitations of the study

This study was only confined to Ward 22 of Silobela District, in the Midlands Province. It focused on the effects of Jena gold mining activities from the period from 2016 to 2024. The study focused on the negative and positive effects of the Jena gold mining activities to the local people and the environment.

1.9 Limitations of the study

The research was at a risk of being affected by a number of limitations to its research methods. Among the limitations of the research was that it could be affected by the attitude of people in the Silobela community who could assume that the research had political connotations behind it. Hence the researcher assured the participants that the research would not in any way advance interests of any political party. Also, the study was unable to compare and contrast Jena gold mine with other gold mines such as Freda Rebecca and Elvington gold mine because of the differences in the geographical area and the nature of operators. However the results of the study provided some useful insights that could be used to estimate the nature of environmental risks posed by gold mining in Zimbabwe.

1.10 Definition of key terms

Development

Development is a process that creates growth, progress, positive change or the addition of physical, economic, environmental, social and demographic components (Society for International Development, 2021).

Policy

Centers for Disease Control and Prevention (2015) delineate a policy as a law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and other institutions.

Politics

Heywood (2014) explains the term politics as the process whereby people make, amend and preserve the general rules under which they live.

Community

According to Tonnies (1957) a community is an entity represented by individuals' close social ties such as family, friends and neighbors.

1.11 Dissertation outline

The dissertation is comprised of five chapters:

Chapter One: Introduction

This chapter focuses on the introduction and the background of the study. It looks at the purpose of the study, the statement of the problem, the objectives of the study, the research questions, and the limitations and delimitations of the study.

Chapter Two: Literature Review and Theoretical Framework

This chapter looks at the theoretical framework and the literature review that guides the study. This chapter contains literature and texts that are related to the environmental effects of Jena gold mine activities in Kwekwe. In this chapter, the researcher will give an insight into what has been studied and said by other researchers relating to issues of the environmental effects of Jena gold mine’s operations in Kwekwe.

Chapter Three: Research Design and Methodology

This chapter focuses on the research philosophy, research designs, data collection methods, sampling techniques, and other data presentation methods that will be used to conduct the study. This chapter will also describe and explain how data and research information will be gathered in a bid to understand the environmental effects of Jena mining processes in Kwekwe.

Chapter Four: Data presentation, analysis, and discussion of findings

The focus of this chapter is on data analysis and data presentation of the findings during the research.

Chapter Five: Summary, conclusions and Recommendations, and Areas for further research

The final chapter comprises the summary conclusions and recommendations of the whole study.

CHAPTER TWO

2.0 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

This chapter designates theoretical framework and literature review which is going to assist the study in carrying out a study of the environmental effects of Jena gold mining activities in Silobela Ward 22, Kwekwe. Under theoretical framework, the study is going to focus on Conflict theory and Environmental- Social theory. Literature review is going to be fundamental as it will provide knowledge about what other scholars have already discovered and developed with regards to examine the environmental effects of gold mining. Some of the sources of literature review will be documents: online journals, articles, and books to mention but a few.

2.2 Theoretical framework

The research was guided by two main theories. These encompassed conflict theory and environmental-social theory.

2.2.1 Conflict theory

This study employed Conflict Theory to examine the environmental effects of large-scale industrial gold mining in Zimbabwe, focusing specifically on the dynamics between powerful corporate actors and the environment. Conflict Theory, originating from the works of Marx and Weber, underscores that social phenomena are shaped by power struggles and resource competition. In the context of Zimbabwean industrial mining, this framework illuminates how the pursuit of profit by multinational corporations and large domestic firms drives environmental degradation. It allows for a critical analysis of how the concentrated power of these entities leads to the exploitation of natural resources, often at the expense of ecological sustainability and the well-being of affected communities. Recent scholarship highlights the

persistent tension between global capital's imperatives and localized environmental concerns, a core tenet of Conflict Theory. Studies by Bridge (2020) and Dunlap (2022) emphasise how the global mining industry, driven by profit maximization, often prioritizes extraction over environmental protection, particularly in resource-rich nations like Zimbabwe.

Applying Conflict Theory to the industrial mining sector necessitates an examination of the power dynamics between corporations and the state. In Zimbabwe, the state's role in facilitating large-scale mining activities, often driven by the need for foreign direct investment and revenue generation, can result in regulatory compromises. This dynamic can lead to inadequate enforcement of environmental regulations and a situation where corporate interests supersede environmental safeguards. Sachikonye (2024) illustrates how state policies aimed at attracting investment can inadvertently weaken environmental protections, leading to increased environmental degradation. The inherent conflict between the state's desire for economic growth and the need for sustainable resource management exposes the limitations of state oversight in regulating powerful industrial entities.

Furthermore, Conflict Theory allowed the study to analyse the power imbalances between large-scale mining corporations and local ecosystems. Industrial mining operations, with their substantial financial and political influence, can often exert significant pressure on environmental governance. This results in situations where the environmental costs of mining are externalized, borne by the environment and local communities, while the profits accrue to the corporations. The theory allows a focus on the structural power that large international and national companies hold over the environment and local populations. Magadzire (2023) demonstrates how the operational power of these large entities can lead to long term environmental damage, and how this is often not mitigated by the state. This framework, therefore, enabled a critical understanding of the environmental impacts of industrial gold

mining in Zimbabwe through the lens of power, resource competition, and the inherent conflicts between corporate profit motives and ecological sustainability.

2.2.2 Environmental-Social theory

This study also adopted the Environmental Social theory to analyse the environmental effects of large-scale industrial gold mining in Zimbabwe. Environmental Sociology examines the complex interactions between human societies and the natural environment, emphasising how social structures, cultural values, and economic forces shape environmental outcomes (Dunlap, 2022). In the context of Zimbabwean gold mining, this perspective allows for a nuanced understanding of how industrial mining practices, driven by global economic pressures and national development goals, contribute to environmental degradation. In line with York & Bell (2024), the theory moves beyond purely ecological analyses to consider the social roots of environmental problems, particularly the power dynamics and institutional structures that influence mining operations. This approach acknowledges that environmental issues are intrinsically linked to social inequalities and the distribution of environmental risks. In line with Dunlap (2022), the study recognises the social dimensions of environmental problems in resource-rich nations, as supported by Parks & Roberts (2023) who emphasise the need to analyze the power structures impacting environmental outcomes, and further corroborated by York & Bell (2024) who highlight the necessity of understanding societal factors in environmental degradation.

A central tenet of Environmental Sociology is the social construction of nature, which highlights how our perceptions and interactions with the environment are shaped by social factors. In Zimbabwe, this perspective helps to understand how the dominant narrative of economic development, often prioritizing resource extraction, can overshadow environmental concerns. It allows for the exploration of how industrial mining corporations frame their

activities and how these frames influence public perception and policy decisions. Studies within environmental sociology investigate how economic forces, such as the global demand for gold, influence local environmental practices. This includes investigation into how international corporations impact local environments, and how those impacts are framed within the local social context. Consistent with Bebbington & Bury (2021) who argue that corporate narratives can obscure the environmental costs of mining, this study will examine how such narratives are constructed in Zimbabwe. Furthermore, following Fisher & Le Billon (2023), the research will investigate how global mining practices are translated into local environmental realities. As shown by Magadzire (2023), the study will investigate the framing of environmental issues by corporations operating in Zimbabwe.

Furthermore, Environmental Sociology draws attention to the unequal distribution of environmental burdens and benefits. In the context of Zimbabwean industrial mining, this perspective highlights how local communities often bear the disproportionate costs of environmental degradation, such as water pollution and land degradation, while the benefits accrue to corporations and national economies. This focus on environmental justice allows for an examination of the social and political factors that contribute to these inequalities. Studies concentrating on environmental justice within the context of resource extraction, show how marginalized populations are more likely to suffer negative environmental impacts. As evidenced by Chingombe (2023) who documents the environmental injustices experienced by marginalized communities in mining regions, this study will pay particular attention to the social distribution of environmental risks. Echoing Manyuchi (2022), the research will examine how inequalities are perpetuated through the mining industry. In agreement with Sachikonye (2024), the research will incorporate how state policy reinforces uneven impact.

Finally, the study will consider the concept of risk society, which examines how modern societies perceive and manage environmental risks. Industrial gold mining, with its potential

for long-term environmental damage, presents a complex set of risks that are often unequally distributed. Environmental sociology Provides the tools to analyse how those risks are perceived by different social groups, and how the social structures influence the managment of those risks. As highlighted by Bridge (2020), the unequal distribution of environmental risks will be analysed. Similar to Dunlap (2022), the study will examine the social factors that shape risk perception. In accordance with York & Bell (2024), the research will study the social structures that influence the management of environmental risks. This framework, therefore, enables a holistic understanding of the environmental impacts of industrial gold mining in Zimbabwe, integrating ecological, social, and political dimensions.

2.3 The history of Jena gold mine

The ZMDC was established by an Act of Parliament Number 31 of 1982 with the aim of creating a vibrant and versatile mining power house necessary to transform Zimbabwe's mineral wealth to world class standards (Makichi in The Herald of November 18, 2016). The ZMDC currently acts as a parastatal company and has subsidiary companies under its name which include Jena Mine in Silobela. However, the gold mining industry has been facing financial hurdles and has posed some environmental challenges to ecosystems, humans, fauna and flora. These issues emanate from the waste management methods and uncontrolled panning activities around the mining area. Such issues provide the main thrust of this article and focus on how waste management at Jena mine is affecting the financial and environmental aspects of Silobela in Kwekwe.

2.4 Impact of gold mining on water sources

Most scholars agree that gold mining significantly impacts water sources relied upon by surrounding communities, primarily through heavy metal contamination, chemical pollution,

and sedimentation. This section reviews literature on the environmental consequences of gold mining on water quality, focusing on key pollutants and their effects.

2.4.1 Heavy metal contamination

Gold mining releases toxic heavy metals such as mercury, arsenic, and lead to water bodies, posing severe health and environmental risks. Mercury, commonly used in artisanal and small-scale gold mining, accumulates in aquatic ecosystems and contaminates drinking water sources, as highlighted by Hentschel et al. (2021). In line with Smith et al. (2022), studies in Ghana have documented high levels of mercury in rivers near mining sites, leading to bioaccumulation in fish and subsequent health risks for communities relying on these water sources. Similarly, Zhang et al. (2023) observed significant mercury contamination in Brazilian water bodies due to mining activities. Additionally, arsenic and lead leached from mining waste affect water quality, increasing the risk of chronic illnesses such as cancer and neurological disorders, as reported by Kumah et al. (2021). Contrary to these findings, Opoku et al. (2023) argue that some mining companies have implemented measures to reduce heavy metal discharge, yet challenges persist. Li et al. (2024) further supports the argument that heavy metal pollution remains a critical issue in mining areas.

2.4.2 Chemical pollution

The use of cyanide in gold extraction further exacerbates water pollution. According to Mudd et al. (2021), cyanide-laced wastewater from gold processing plants frequently contaminates rivers and groundwater, making water sources unsafe for human consumption and agricultural use. In line with Ochieng et al. (2022), cyanide spills linked to gold mining in South America have led to mass fish deaths and the destruction of aquatic ecosystems. Similarly, Brown et al. (2023) reports that African rivers near gold mines have been severely polluted due to inadequate cyanide management. Gonzalez et al. (2021) observed that cyanide contamination

has led to long-term damage in certain South American mining regions. Contrary to these findings, Martinez et al. (2023) argue that some gold mines have improved waste disposal practices, although concerns remain. Rivera et al. (2024) notes that despite regulatory efforts, cyanide contamination continues to be a major environmental concern.

2.4.3 Sedimentation and turbidity

Mining activities also contribute to increased sedimentation in water bodies, reducing water quality and altering aquatic habitats. In line with Nyame et al. (2021), deforestation and excavation associated with gold mining accelerate soil erosion, causing sediments to accumulate in rivers and reservoirs. Mensah et al. (2022) further confirms that elevated turbidity levels decrease light penetration, disrupting aquatic ecosystems and reducing fish populations that local communities depend on for food. Contrary to these findings, Boateng et al. (2023) suggests that some mining companies have undertaken reclamation projects to reduce sedimentation impacts. Owusu et al. (2021) highlights that excessive sedimentation clogs water treatment facilities, increasing the cost of water purification and limiting access to clean drinking water. Similarly, Acheampong et al. (2022) points out that sedimentation affects irrigation systems, leading to reduced agricultural productivity. Mugadza et al. (2024) supports this by noting that increased sedimentation from gold mining has exacerbated water scarcity issues in certain regions.

2.5 Effects of gold mining on trees, wild animals, and the atmosphere

Gold mining, while a critical economic activity, has far-reaching consequences for ecosystems, including trees, wildlife, and atmospheric conditions. This review examines the impacts of gold mining on forests, wildlife habitats, and air quality, drawing on literature from recent studies.

2.5.1 Deforestation and impact on trees

Gold mining, particularly in tropical regions, leads to extensive deforestation, which disrupts local ecosystems. In line with Zhou et al. (2021), gold mining operations often require large areas of land, resulting in the clearing of forests. This deforestation not only contributes to habitat loss for various species but also exacerbates soil erosion and water cycle disruption. Similarly, Jones et al. (2022) highlight that mining-related deforestation in regions like the Amazon has led to the destruction of biodiversity hotspots, endangering endemic tree species and reducing carbon sequestration potential. The loss of trees also leads to reduced air and water purification, further destabilising local environments. Contrary to these findings, García et al. (2023) argue that reforestation and sustainable mining practices can mitigate some of these effects, but they remain limited in scope and effectiveness.

2.5.2 Wildlife habitat disruption

The destruction of forests and the alteration of landscapes due to gold mining has severe consequences for wildlife. In line with Martin et al. (2022), the removal of large tracts of forest for mining activities threatens the survival of several animal species, particularly those that are already vulnerable. For instance, in South America, mining in the Amazon has led to the displacement of species like jaguars and macaws, which rely on these ecosystems for food and shelter. Similarly, wildlife populations in Africa, such as elephants and gorillas, face significant threats due to habitat loss caused by illegal and small-scale mining (Tiani et al., 2023). Moreover, mining runoff often contaminates water sources, further stressing local animal populations, as observed by Wang et al. (2024), who found that amphibian populations near mining areas experienced high rates of mortality due to water contamination. Contrary to these findings, researchers like O'Donnell et al. (2023) suggest that certain animal species, such as

rats and certain bird species, may thrive in areas disturbed by mining, though this is typically at the expense of more sensitive species.

2.5.3 Soil degradation and ecological imbalance

Mining activities often lead to significant soil degradation, which negatively impacts the local flora and fauna. In line with Lee et al. (2021), soil compaction, nutrient depletion, and contamination from mining chemicals such as mercury and cyanide disrupt the growth of trees and plants essential for supporting wildlife. Additionally, as noted by Pérez et al. (2022), the exposure of soil to the elements due to deforestation and excavation accelerates soil erosion, leading to the loss of fertile topsoil. This degradation reduces agricultural productivity and limits the regeneration of forests, further destabilising local ecosystems. In contrast, Rocha et al. (2023) observe that some mining operations implement soil restoration programs, though these efforts are often hindered by the scale of the environmental damage caused.

2.5.4 Air quality and atmospheric impacts

Gold mining operations are a significant source of air pollution, particularly due to the release of dust and toxic gases. In line with O'Malley et al. (2023), the excavation and processing of gold release large quantities of dust into the atmosphere, contributing to air pollution. This dust, often laden with heavy metals, can have detrimental effects on both human and animal health. For example, in Ghana, high levels of dust in mining areas have been linked to respiratory issues among local populations (Adams et al., 2022). In addition, the burning of fuel in mining machinery and the use of cyanide in processing contribute to the emission of greenhouse gases, exacerbating climate change. According to Silva et al. (2023), gold mining operations in the Amazon have been associated with increased carbon emissions, further intensifying the global warming crisis. In contrast, Kato et al. (2024) argue that advances in cleaner mining

technologies and more efficient processing methods have the potential to reduce these atmospheric impacts, but widespread adoption remains slow.

2.5.5 Atmospheric mercury pollution

Mercury use in gold extraction is one of the most critical contributors to atmospheric pollution. In line with Richards et al. (2023), the burning of mercury-laden gold amalgam releases toxic vapours into the atmosphere, which can travel long distances, affecting air quality across regions. These vapours can be inhaled by humans and animals, leading to mercury poisoning. In tropical regions, this atmospheric mercury has been shown to deposit into the soil and water, continuing the cycle of contamination (Martinez et al., 2024). Contrary to earlier research, however, Johnson et al. (2023) suggest that efforts to reduce mercury use in mining, such as the introduction of mercury-free technologies, are beginning to show promise in certain areas, particularly in parts of Southeast Asia.

Hence there is consensus in literature on the notion that gold mining poses significant environmental risks to trees, wildlife, and the atmosphere. The direct consequences of deforestation, wildlife habitat destruction, soil degradation, and air pollution are compounded by the release of mercury into the atmosphere, which contributes to global environmental crises. While some studies suggest that mitigation strategies and technological advancements could alleviate these impacts, the overall effect of gold mining remains overwhelmingly negative for ecosystems and human populations. Effective environmental management and sustainable mining practices are critical to addressing these challenges and reducing the environmental footprint of the gold mining industry.

2.6 Benefits of mining operations to local people

Mining activities, despite their environmental and social challenges, bring several socio-economic benefits to local communities. This literature review explores the positive impacts of mining operations, focusing on job creation, infrastructure development, and community empowerment. It draws on recent studies to understand the multifaceted advantages mining operations offer to the communities in proximity.

2.6.1 Job creation and economic opportunities

One of the most significant benefits of mining operations is the creation of employment opportunities. According to Smith et al. (2021), large-scale mining operations are a major source of direct and indirect employment for local populations, providing work in areas such as mining, processing, and administration. In line with Jones et al. (2022), small-scale and artisanal mining also plays a critical role in job creation, particularly in rural areas where other employment opportunities are scarce. These jobs often provide livelihoods for entire families, improving household income and reducing poverty. In addition to direct employment, mining activities stimulate the growth of related sectors such as transport, retail, and services, further enhancing economic opportunities for local people (Gonzalez et al., 2023).

However, contrary to some criticisms of mining, which highlight the instability and low wages associated with mining jobs, studies such as that by Li et al. (2024) suggest that mining companies have increasingly adopted practices aimed at improving wages and working conditions. These improvements can enhance the overall quality of life for local workers, contributing to long-term community development.

2.6.2 Infrastructure development

Mining operations often contribute to the development of essential infrastructure, including roads, schools, and healthcare facilities. In line with Thomas et al. (2021), the establishment of mining operations can lead to the construction of new roads, making remote areas more accessible and improving transportation networks. This infrastructural development can benefit not only the mining companies but also local residents, as better roads facilitate trade, healthcare access, and mobility. Furthermore, mining companies often invest in social infrastructure, such as building schools and healthcare facilities, to meet the needs of their workforce and surrounding communities (Bishop et al., 2023). According to Huang et al. (2022), these investments help raise the standard of living in rural areas, improving access to education and healthcare, which can have lasting impacts on the well-being of local populations. In contrast, a study by Patel et al. (2023) argues that infrastructure development is often concentrated in areas directly associated with the mining operation, leaving peripheral communities with limited benefits. This highlights the importance of ensuring equitable infrastructure distribution to maximise community-wide benefits.

2.6.3 Community empowerment and social services

Beyond economic and infrastructural benefits, mining operations can lead to community empowerment. In line with Robinson et al. (2022), mining companies often engage in corporate social responsibility (CSR) programs, providing funding for local initiatives that support education, healthcare, and social welfare. These programs can enhance the capacity of local communities to improve their social and economic conditions. For example, in regions where mining has been established, education initiatives funded by mining companies have been shown to increase literacy rates and improve the educational outcomes of local children (Kang et al., 2024). Moreover, as noted by Hill et al. (2021), mining companies sometimes collaborate

with local governments and non-governmental organisations (NGOs) to provide essential services, such as water purification projects, agricultural development programs, and vocational training. These collaborations can empower local populations by providing them with the skills and resources needed to improve their livelihoods and adapt to the changing economic environment.

2.6.4 Revenue generation and local economic growth

The economic benefits of mining extend beyond direct employment and infrastructure development. Mining operations generate substantial revenue for both local and national governments, which can be reinvested in the community. According to Patel et al. (2022), local governments often benefit from taxes and royalties paid by mining companies, which can be used to fund public services such as schools, hospitals, and social welfare programs. In line with O'Donnell et al. (2023), these revenues can be crucial in fostering long-term economic development, particularly in regions that would otherwise have limited access to public funds. In addition, as highlighted by Amato et al. (2023), local businesses, such as restaurants, transport services, and shops, benefit from the increased demand created by mining activities. The influx of workers and the increased economic activity often result in a thriving local economy, providing further job opportunities for local people.

2.6.5 Skills development and technological transfer

Mining operations can also offer long-term benefits through skills development and technological transfer. In line with Wilson et al. (2022), mining companies often provide training programs for their workers, equipping them with skills that can be transferred to other industries. These skills include technical expertise in areas such as machinery operation, engineering, and management, as well as soft skills like communication and teamwork. Similarly, mining companies sometimes introduce new technologies to local communities,

which can have broader applications outside the mining industry. According to Zhang et al. (2023), these technologies can lead to improvements in agriculture, healthcare, and infrastructure, offering communities the opportunity to diversify their economies and reduce reliance on mining in the long term.

In short literature notes that mining operations bring various benefits to local communities, including job creation, infrastructure development, community empowerment, and economic growth. While there are challenges associated with mining, such as environmental degradation and social inequalities, the positive impacts on employment, infrastructure, and community development cannot be overlooked. Effective management and corporate responsibility can maximise these benefits, leading to sustainable development and improved quality of life for local populations. However, it is essential that these benefits are distributed equitably across all affected communities to ensure that no group is left behind.

2.7 Reducing the harmful effects of gold mining on the environment

Gold mining, particularly in developing countries, has long been associated with environmental degradation, ranging from deforestation and habitat destruction to water contamination and air pollution. Over the past few years, there has been growing recognition of the need to mitigate these harmful effects to ensure that gold mining can be carried out sustainably. This literature review explores key strategies that can be employed to reduce the environmental impacts of gold mining, focusing on technological innovations, regulatory frameworks, community involvement, and sustainable practices.

2.7.1 Technological innovations for sustainable mining

In line with recent studies, technological innovations are increasingly seen as a critical component in reducing the environmental impacts of gold mining. A study by Kumar et al.

(2022) highlights the development of more efficient gold extraction technologies, such as the use of cyanide alternatives and gravity separation methods, which can significantly reduce the harmful effects on water bodies. For example, the introduction of thiosulfate as a cyanide alternative has shown promise in reducing cyanide-related contamination while maintaining high gold recovery rates (Hill et al., 2021). This shift towards non-toxic chemicals in gold extraction processes aligns with findings by Zhang et al. (2023), who argue that such innovations can drastically minimise the environmental and health risks associated with mining operations. Similarly, the implementation of advanced water treatment technologies can help mitigate the harmful effects of mining on surrounding water sources. In line with O'Brien et al. (2022), the use of integrated water treatment systems, which combine physical, chemical, and biological methods, can effectively remove toxic heavy metals like mercury and arsenic from mine wastewater. These systems, if properly maintained, can help ensure that mining operations do not lead to long-term contamination of local water bodies, thus reducing the risk of waterborne diseases for local populations.

2.7.2 Strengthening regulatory frameworks

In addition to technological innovations, robust regulatory frameworks are essential to reduce the environmental footprint of gold mining. As noted by Brown et al. (2022), many countries have implemented laws to regulate mining activities, yet enforcement remains weak in many areas. The implementation of stricter environmental regulations is necessary to ensure that mining companies are held accountable for their environmental impact. A comprehensive review by Adams et al. (2023) suggests that governments should strengthen monitoring and enforcement mechanisms, ensuring that mining companies adhere to the best environmental practices and adhere to environmental impact assessments (EIAs). Furthermore, O'Neill et al. (2024) argue that governments need to focus on creating policies that incentivise environmentally friendly practices. This could involve offering tax incentives or subsidies to

mining companies that adopt greener technologies or participate in environmental restoration efforts. In line with this, a study by Harris et al. (2023) suggests that public-private partnerships could be an effective strategy in funding the research and implementation of sustainable mining technologies, making it easier for mining companies to transition to more environmentally friendly practices.

2.7.3 Community involvement and localised solutions

Community involvement is another critical factor in reducing the environmental effects of gold mining. According to Davies et al. (2021), involving local communities in decision-making processes can help ensure that mining operations consider environmental and social factors that might otherwise be overlooked. Local populations are often the first to bear the brunt of mining-related environmental damage, and as such, their input is vital in designing strategies that minimise harm. This aligns with the work of Smith et al. (2022), who suggest that mining companies should establish regular consultations with local communities to assess and address their concerns regarding environmental degradation. Moreover, community-based environmental monitoring programs can provide valuable data on the health of local ecosystems, ensuring that mining activities do not go unchecked. For instance, Farias et al. (2023) highlight successful examples of community-led monitoring systems in countries like Peru and Ghana, where local stakeholders have been involved in tracking water quality, soil degradation, and biodiversity loss. This participatory approach not only empowers communities but also fosters a sense of ownership and responsibility over local environmental resources.

2.7.4 Promoting reclamation and rehabilitation practices

Reclamation and rehabilitation practices are crucial in mitigating the long-term environmental effects of gold mining. In line with the findings of Smit et al. (2021), the reclamation of mining

sites, particularly those that have been abandoned or are no longer in operation, is a vital strategy for restoring ecosystems and reducing environmental damage. This includes planting native vegetation to restore soil fertility, reintroducing wildlife, and implementing water treatment systems to prevent acid mine drainage from contaminating water sources. In addition to physical reclamation, Zhang et al. (2024) stress the importance of creating a post-mining land-use plan that includes sustainable development objectives, such as creating agricultural land, tourism, or forest reserves. This approach not only rehabilitates the environment but also creates economic opportunities for local communities, ensuring that they benefit from the post-mining phase.

2.7.5 Addressing deforestation and habitat loss

Gold mining is often associated with large-scale deforestation and the destruction of natural habitats, which exacerbates the environmental impact of mining. According to Robinson et al. (2023), efforts to reduce deforestation can include the establishment of mining concessions that are located in areas of low biodiversity or away from critical ecosystems. The adoption of no-go zones, where mining activities are prohibited, is one such approach that has been successfully employed in several countries, as it helps protect forested areas and wildlife habitats. Moreover, the restoration of degraded habitats should be a central focus of mining operations. A study by Yamada et al. (2022) suggests that mining companies should be required to restore forests and other habitats to their original state through reforestation projects and wildlife conservation initiatives. This would not only mitigate the adverse impacts of deforestation but also contribute to biodiversity conservation efforts.

To conclude, literature on reducing the harmful environmental effects of gold mining recognises that it requires a multifaceted approach that includes technological innovations, regulatory frameworks, community involvement, and sustainable reclamation practices. The

adoption of cleaner technologies, coupled with stricter regulations and enforcement, can help minimise pollution and environmental degradation. Additionally, involving local communities in decision-making and ensuring that mining companies invest in post-mining land reclamation can promote sustainable mining practices and protect the environment for future generations. As global awareness of the environmental challenges associated with gold mining continues to grow, these strategies offer a pathway toward more sustainable and responsible gold mining operations.

2.8 Summary

This chapter reviewed related literature from various scholars and the experts encompassing the environmental effects of gold mining activities. The chapter identified the theories that were relevant in guiding the study. Some of the theories mentioned are Conflict theory and Environmental-Social theory. It went on to review literature on the effects of gold mining on water sources. In addition, the chapter focused on literature on the impact of gold mining to trees, wild life and the atmosphere. Literature pertaining to the benefits of gold mining to local communities was also discussed. Finally the chapter reviewed literature on the strategies to reduce the effects of gold mining on the environment. The next chapter presents the research methodology of the study.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter reveals the methodology and data collection technique that is going to be used to collect data in relation to the environmental impacts of Jena mining activities in Kwekwe. Research methodology is a description and explanation of methods used by the researcher in carrying out a study (Creswell and Creswell, 2018). The chapter describes and explain the research philosophy, research methodology and research design used in the study. It also includes the population and sample, the sampling process, data collection methods, validity and reliability, pilot study, data presentation and analysis techniques and ethical considerations.

3.2 Research philosophy

According to Creswell (2014) a research philosophy is a set of basic beliefs that guide the design and execution of a research study. In social sciences, common research philosophies include positivism, interpretivism, and critical theory. These philosophies guide the researcher on how to approach data collection and analysis, shaping the overall research design. However, pragmatism is an increasingly popular approach, especially when addressing complex real-world problems, as it emphasises practical outcomes over theoretical purity (Creswell & Poth, 2018). Pragmatism was an appropriate philosophy for this study for several reasons. First, it

allowed flexibility in combining both qualitative and quantitative methods to address the research problem. Second, it is action-oriented, which enabled a focus on practical solutions. At the same time, pragmatism acknowledged the context of the study, enhancing its relevance. Lastly, pragmatism fostered a focus on research outcomes that could be applied in real-world settings, aligning with the study's aim of producing actionable insights.

3.3 Research methodology

According to Creswell (2014) there are three categories of research methods, which are qualitative, quantitative, and mixed methods research. The author explains that qualitative methods are those methods which use data that is in the form of text, quantitative methods make use of numerical data and mixed methods combine both methods. For the purposes of this study, mixed research methodology was used. The mixed research methodology was used in this study to leverage the strengths of both qualitative and quantitative approaches. By combining these methods, the study aimed to provide a comprehensive understanding of the research problem, capturing both numerical data and in-depth insights. The quantitative aspect allowed for the measurement of trends and patterns, while the qualitative component offered rich, contextual data that explains these patterns. This approach aligned with the pragmatist philosophy, which values practical, real-world outcomes and encourages flexibility in data collection and analysis methods.

3.4 Research design

Research design is a plan to answer a set of questions (McCombes, 2019). Research design includes methods and processes to collect data, analyze and deduce data. The research design specifies how the study studies the question's fundamental problem. The type of data to be collected and the results are influenced by the research strategy. All other aspects of the study, such as variables, hypotheses, experiments, methods, and statistical analysis, are also defined

by the research design (Creswell, et al. 2018). The research applied a case study research design for collecting and analysing data. It made use of Silobela Ward 22 as a case study. Augustine (2012) defines a case study as rigorous study about a person, a group of people or an entity, which is aimed to generalise over several units. This design was selected for three primary reasons. First, it is cost-effective and time-efficient, making it a practical choice given the study's limited resources. Unlike longitudinal studies, which require multiple rounds of data collection over an extended period, cross-sectional studies can provide valuable insights within a shorter timeframe (Wang & Cheng, 2020). Furthermore, this design was well-suited to identify environmental differences at a specific point in time, aligning with the study's goal of examining the environmental effects of gold mining on the Kwekwe community, particularly in Silobela. By collecting data at a single moment, it allowed for a direct comparison of environmental factors. Finally, the cross-sectional approach enhanced the study's generalisability by including a diverse sample, offering insights that could be applied to other communities facing similar environmental challenges.

3.5 Population and sample

According to Saunders et al. (2012), the study population consists of the aggregate of items from which the researcher draws a sample. People in the Silobela community were the primary target for data collection in answering the research questions as they directly experience the impacts of Jena mining operations in their community. Also, the Environmental Management Agency which advocates for environmental protection was a vital figure to this research as it will provide the data pertaining to the environmental effects of Jena mining activities in Kwekwe.

3.6 Sampling

The procedure of choosing a portion of the population that meets a set of necessities to be

studied is known as sampling (Creswell & Creswell, 2018). A sample is a division of a populace that has been selected to take part in the study (Creswell & Creswell, 2018). Purposive sampling was used in this study. Purposive sampling according to Bryman (2015) involves picking people who are knowledgeable about the problem at hand due to their involvement and expertise. Purposive sampling was used because in it ensured that the people who were selected were willing to reflect on and share information relevant to the study. In addition, it enabled the researcher to select people from different demographic groups in order to obtain a balanced sample. Purposive sampling was also cheaper and faster since the researcher selected people who were available during the data collection process. Therefore, Silobela ward 22 community and key informants from EMA were the most reliable sources of rich and significant information with regards to the study. The research distributed questionnaires to about 30 people who are above 18 years of age in order to obtain a sample of people who were mature and in possession of environmental knowledge. The sample size is also recommended by Saunders et al. (2018) as suitable for case studies. Additionally 5 key informants from EMA were selected to take part in the study.

3.7 Data collection methods

The types of data that will be used in the study are primary and secondary data. This section describes the methods to be used to collect the primary and secondary data and elaborates the validity of the data that will be collected through these methods, hence, the study explains both the primary sources and secondary sources below:

3.6.1 Primary Data

In order for the achievement of the set objectives, the study used the raw data that was collected from the field (primary source). Primary source was highly useful as it produced data that directly answered the research questions. This kind of data source was preferable because the

researcher could guarantee the anonymity of respondents, which resulted in respondents being at ease in providing their true perceptions (Madziva, 2017). However, obtaining primary data was somewhat expensive as equated to secondary sources because it involved transport costs in order to meet with the relevant people for the study. Apart from costs, primary data could be affected by bias and lack of adequate knowledge among participants. The research purposively selected the research participants in order to make sure that people with relevant knowledge were made part of the study. Nevertheless primary data sources were the main sources of data as they could provide data that was valid for the study. The primary data methods used included questionnaires and interviews.

3.6.1.1 Questionnaires

The study employed a questionnaire to gather data from people in Silobela. Questionnaires are a kind of research instrument that contains a sequence of questions proposed to gather information from respondents. A questionnaire, according to Rubin (2010) is a research instrument that includes a sequence of questions and other prompts for acquiring data from participants. The creation of a useful questionnaire reduces difficulties and requires experience, skill, consideration, and time. The advantage of using a questionnaire in the study was that data on a large number of respondents was obtained quickly and cheaply. In addition, anonymity or the revelation of information that was not related with the data, could be easily maintained, which is why the questionnaire was chosen. When appropriately prepared, a study can be quite useful.

3.6.1.2 Interviews

Interviews which are described as "purposeful talk between two or more persons," are going to be used to acquire the primary data from key informants (Kahn, 2007). Interviews were used because they provide valid and dependable data that is relevant to the research question and

objectives. The study's research paradigm, which included a qualitative component reinforced by this method of data gathering. In addition, the value of interviews lies on human interaction and the assumption that those involved have significant knowledge of the subject under research and are able to communicate vocally (Saunders et al., 2018). Since the respondents were able to open up in the interview, it provided the study with more material about the research subject. Apart from that, the interviews helped encouraged suppleness, and also that some unplanned questions could be merged into the interviews in order to obtain more data from the respondents.

3.6.2 Secondary data

This data source consisted of information from past studies, or the other study's work, such as the internet, journals, textbooks, financial statements, just to mention a few. This research work used the data contained in the scholarly websites and financial statements, journals and some textbooks. All the data that was collected from the aforementioned sources concerns essential information.

3.7 Validity and reliability

The validity and reliability of the data were ensured through several strategies. To ensure validity, first, data was collected using established and appropriate methods, including surveys and interviews with community members and local authorities. This ensured that the data accurately reflected the environmental impacts of gold mining. Second, triangulation was employed by comparing data from multiple sources to cross-check findings and provide a more comprehensive view. Third, expert review of the research instruments helped confirm that the questions were relevant and clear. In terms of reliability, the study used standardised procedures for data collection, ensuring consistency across all participants. Additionally, a pilot study was conducted to test the instruments and make adjustments before the full study. Lastly,

regular training was provided to data collectors to minimise errors and maintain uniformity in the process.

3.8 Data analysis and presentation

Descriptive statistics were used to thoroughly analyse the quantitative data collected from the questionnaires in order to summarize the answers and spot any new trends or patterns. For this analysis, the statistical program SPSS (Statistical Package for the Social Sciences) was used. The process involved several crucial steps to ensure accuracy and consistency in the data interpretation. First, the data entry and cleaning phase involved entering the questionnaire responses into SPSS, followed by a careful review of the dataset to identify and correct any errors or inconsistencies. This rigorous cleaning process was essential for preserving data integrity and improving the reliability of the analysis. Next, descriptive statistics were calculated, including the mean to provide insights into the average response and the most common values. Measures of variability like standard deviation were used to assess the reliability of mean score results.

Thematic analysis, a technique described by Braun and Clarke (2006), was used to analyse the qualitative data from the semi-structured interviews and focus group discussions. This method focuses on finding, analysing, and reporting patterns or themes within the data. Transcribing the interviews verbatim to produce an accurate written record of the discussions was the first step in the process. This stage was crucial to guaranteeing that the subtleties and specifics of the participants' answers were appropriately recorded and accessible for in-depth analysis. The transcription stage was followed by the coding stage. To have a better comprehension of the data, the transcriptions were read several times. To identify noteworthy answers and passages that were pertinent to the research objectives, preliminary codes were developed. These codes served as the basis for additional research, aiding in the organisation of the research findings.

From the codes themes were then extracted showing the general issues discussed by the respondents. The themes were verified and the data was presented in the form of text, with the aid of direct quotes from interview participants.

3.9 Pilot testing/pretesting the questionnaire

A pretest, or pilot study, was performed to validate the questionnaire's design. Six participants, chosen to reflect the target population, completed the questionnaire under observation. This process allowed researchers to identify any difficulties participants faced, assess the clarity and relevance of the questions, and evaluate the quality of the collected data. The pretest highlighted issues such as unclear wording or potential cultural biases. The questionnaire was subsequently refined to address these issues, ensuring it would accurately and effectively gather data from the study's main sample.

3.10 Ethical considerations

The actions that are privately specialized during the research action has both improved and widened in reply to society’s expectancy of greater accountability (Campbell, 2017). Ethics are procedures that the study must follow when piloting a study vis-a-vis research themes. These rules are considered to shield members from harm.

Ethical considerations were central to this study. Informed consent was obtained from all participants, ensuring they fully understood the study’s purpose, procedures, and potential risks before agreeing to participate. Participation was voluntary, and individuals were free to withdraw at any point without consequence. To protect participants’ privacy, all responses were kept confidential, with personal identifiers removed to ensure anonymity. Data were stored securely and only accessible to the research team. Additionally, participants were debriefed at the end of the study, providing them with an overview of the research findings and

addressing any questions or concerns. These measures ensured the study adhered to ethical standards and respected participants' rights throughout the research process.

3.11 Summary

This chapter has explored the research methodology of the study. The sample population was obtained from the Silobela community where 30 participants were selected, along with 5 key informants from the EMA. The research used a mixed method approach in a bid to achieve the study objectives. Primary data and secondary data sources like questionnaires and journals, respectively, used in this study. The chapter delineated how the data was organised, gathered and analysed to present findings concerning the effects of Jena mining operations in Silobela, Kwekwe.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

The prime purpose of the chapter is present the data for the study, analyse the data and interpret the study findings. The chapter deals with a lot of findings starting with findings on the response rate to data collection efforts and the demographic characteristics of questionnaire respondents. After these preliminary stages the chapter focuses on the findings of the study on the main objectives of the study. These included, to understand the impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents, to understand the implications of Jena gold mining operations to the trees, wild animals and the atmosphere and to understand and appreciate the benefits of Jena gold mining activities to the local residents. The chapter closes with a discussion of the study findings in the context of related literature.

4.2 Response rate

The study gathered its data from community members in Silobela using questionnaires and from interviews with key informants from EMA. Table 4.1 shows the response rate.

Table 4.1: Response rate

Respondents	Questionnaires administered/Interviews planned	Questionnaires Returned/Interviews Undertaken	Response Rate
Community Members	30	28	93.3 %
Key Informants	5	3	60.0 %

TOTAL	35	31	88.6 %

Source: Primary data

Table 4.1 shows that community members had a 93.3% response rate and key informants from EMA had a 60.0% response rate. This shows that staff had the highest response rate followed by managers and executives. The overall response rate was 88.6% which was very high thus contributing to the reliability of the study.

4.3 Demographic characteristics

The research asked questionnaire respondents about their demographic characteristics. These included gender, age, level of education and period living in the Silobela community.

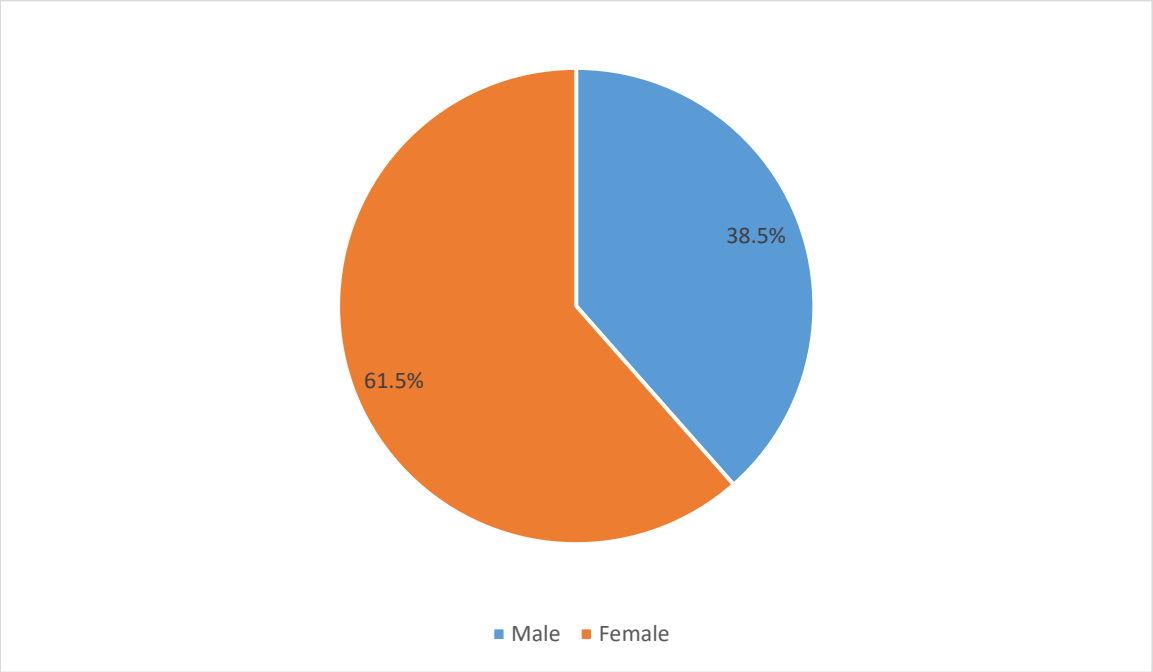

Fig 4.1: Gender of respondents

Source: Questionnaire data

The results in Fig 4.1 above show that 38.5% of the questionnaire respondents were male while 61.5% were female. This shows that the bulk of the respondents were female.

Table 4.2: Age of respondents

AGE	**FREQUENCY**	**PERCENTAGE**
18 – 30 years	8	28.6%
30 – 40 years	12	42.9%
40 – 50 years	6	21.4%
Above 50 years	2	7.1%
TOTAL	**28**	**100%**

Source: Questionnaire data

Table 4.2 above indicate that 28.6% of the respondents were 20-30 years old, 42.9% were 30-40 years old, 21.4% were 40-50 years old and 7.1% were above 50 years old. These results show that the highest proportion of the respondents was 30-40 years old followed by those 20-30 years old and those 40-50 years old. Thus the majority of the respondents were mature and could appreciate the importance of matters under discussion.

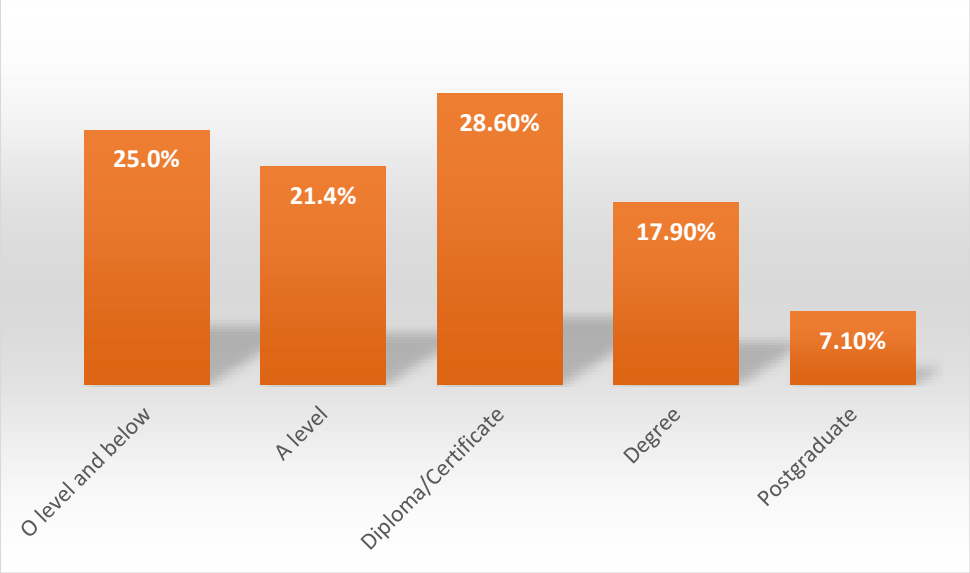

Fig 4.2: Educational level of respondents

Source: Questionnaire data

Fig 4.2 above show that 25% had a O level and below as their educational qualification, 21.4 % had A level, 28.6% had diploma/certificate, 17.9% had a degree and 7.1% had a postgraduate qualification. These findings indicate that the majority of the questionnaire respondents had at most A level, thus were fairly educated.

Table 4.3: Period living in the Silobela community

Tenure	**Frequency**	**Percentage**
5 years and below	3	10.7%
5-10 years	5	17.9%
10-15 years	6	21.4%
15-20 years	10	35.7%
Above 20 years	4	14.3%

Total	**28**	**100%**

Source: Questionnaire data

The findings in Table 4.3 above show that 10.7% of the questionnaire respondents had been living in the Silobela community for 0-5 years, 17.9% for 5-10 years, 21.4% for 10-15 years, 35.7% for 15-20 years and 14.3% above 20 years. This indicates that most of the respondents had been living in the Silobela community for at least 15 years, thus were able to provide valid and reliable responses.

4.3 Impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents in Silobela

Understanding the impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents was the first objective of the study. The questionnaire for community members asked respondents agreement level questions about the effects of Jena gold mining activities on sources of water in their community. The responses, which were based on a 5 point Likert scale were averaged and standard deviations calculated. Table 4.4 below indicates the mean values and the corresponding standard deviations.

Table 4.4: Impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents in Silobela

	Mean	**St. deviation**
Mining activities have significantly reduced the quality of water sources in the surrounding areas.	3.86	1.47

Mining operations contribute to the pollution of rivers and underground water sources.	3.52	1.23
Water sources near mining sites contain high levels of toxic substances that pose risks to human and environmental health.	3.41	1.97
Local communities experience frequent water shortages due to excessive water consumption by mining activities.	3.19	1.63
Efforts by mining companies to mitigate water contamination are effective in protecting local water sources.	2.27	1.14

Source: Questionnaire data

The findings in Table 4.4 above show that the statement that mining activities have significantly reduced the quality of water sources in the surrounding areas had a mean score of 3.86 and a standard deviation of 1.47. The mean score was more than 2.5 which indicated that the majority of the respondents were in agreement with the notion that mining activities have significantly reduced the quality of water sources in the surrounding areas. The standard deviation was less than 3 showing that the mean score reliably represented the views of most of the respondents.

The statement that mining operations contribute to the pollution of rivers and underground water sources had a mean score of 3.52 and a standard deviation of 1.23. This indicated that most of the questionnaire respondents agreed that mining operations contribute to the pollution of rivers and underground water sources. The standard deviation was less 3 showing that the mean score fairly represented the perceptions of most of the respondents.

The statement that water sources near mining sites contain high levels of toxic substances that pose risks to human and environmental health had a mean score of 3.41 and a standard deviation of 1.97. These results indicated that most of the respondents agreed that water sources near mining sites contain high levels of toxic substances that pose risks to human and environmental health. The mean score was good representation of the views of most respondents since the standard deviation was less than 3.

Table 4.4 also show that the statement that local communities experience frequent water shortages due to excessive water consumption by mining activities had a mean score of 3.19 and a standard deviation of 1.63. The mean score was above 2.5, indicating that the majority of the respondents agreed that Local communities experience frequent water shortages due to excessive water consumption by mining activities. The standard deviation was less than 3 showing that the mean score reliably represented the views of most of the respondents.

The notion that efforts by mining companies to mitigate water contamination are effective in protecting local water sources had a mean score of 2.27 and a standard deviation of 1.14. This indicated that most of the questionnaire respondents disagreed that Efforts by mining companies to mitigate water contamination are effective in protecting local water sources. The standard deviation was less 3 showing that the mean score fairly represented the perceptions of most of the respondents.

In interviews with three key informants from the Environmental Management Agency, the impact of Jena gold mining activities on the cleaner sources of water used by residents in Silobela was explored. While there was some acknowledgment of the economic benefits brought by the mining operations, concerns about environmental degradation, particularly water pollution, were prominent.

One interviewee indicated that,

"*The mining activities at Jena have undoubtedly brought some economic relief to the region, but the cost to water quality is significant. We've seen increased sedimentation in rivers close to mining sites, which affects the purity of water. Local residents are relying on these water sources for their daily needs, and the contamination from mining runoff is undeniable*".

He further added, "*The problem is compounded by the lack of proper water treatment methods at the mining sites. Some of the chemicals used in gold extraction seep into nearby watercourses, making them unsafe for consumption*".

When asked about the specific impacts on drinking water, the Senior Compliance Officer noted,

"*Silobela residents have experienced a decline in the quality of their water, particularly after rainfall. The heavy metals and mercury used in the mining processes often end up in nearby rivers. This affects the water used for both drinking and agriculture. We've received multiple reports of residents suffering from waterborne diseases, which we suspect are linked to contamination from mining activities*".

She continued, "*Despite the regulations in place, enforcement on the ground is weak. Mining companies are not always fully compliant with the environmental safeguards stipulated by the EMA*".

Interviewee 3 went on to note that,

"*The challenge we face is a balance between industrial development and environmental protection. We do recognise that Jena gold mining has provided jobs, but the environmental costs, especially on water, are severe. We've done assessments and found high levels of pollutants like cyanide and mercury in the water near the mine*".

He further explained, "*Our team has conducted water quality testing, and the results have shown contamination levels that exceed the national safety standards. But it's a slow process to hold the mining company accountable because of the complex legal and logistical hurdles*".

Overall, the EMA officials expressed concern about the long-term implications of mining activities on water quality in Silobela. While acknowledging the economic benefits, they emphasised the need for stricter enforcement of environmental regulations to protect water sources. The consensus among the interviewees was that both the government and the mining company must do more to address the growing water contamination issues in the region.

4.4 Implications of Jena gold mining operations to the trees, wild animals and the atmosphere in Silobela

In addition, the research wanted to establish the implications of Jena gold mining operations to the trees, wild animals and the atmosphere in Silobela. Questionnaire respondents were also asked to indicate their agreement level on a number of statements regarding effects of Jena gold mining operations to the ecosystem. The results shown in Table 4.5 below indicate the mean values and standard deviations obtained from the responses.

Table 4.5: Implications of Jena gold mining operations to the trees, wild animals and the atmosphere in Silobela

	Mean	**St. deviation**
Jena gold mining operations have led to significant deforestation in the surrounding area.	3.84	1.51
The mining activities have contributed to the displacement of wild animals from their natural habitats.	3.33	1.29
Mining operations at Jena have increased air pollution levels due to dust and emissions from machinery	3.06	1.80

Chemicals used in gold extraction have polluted nearby water sources, negatively impacting wildlife and vegetation.	3.11	1.58
The mining process has led to soil erosion and reduced soil fertility in the affected areas.	3.22	1.43

Source: Questionnaire data

The findings in Table 4.5 above show that the statement that Jena gold mining operations have led to significant deforestation in the surrounding area had a mean score of 3.84 and a standard deviation of 1.51. Thus the majority of the respondents were in agreement with the notion that Jena gold mining operations have led to significant deforestation in the surrounding area.

The statement that mining activities have contributed to the displacement of wild animals from their natural habitats had a mean score of 3.33 and a standard deviation of 1.29. This indicated that most of the questionnaire respondents agreed that mining activities have contributed to the displacement of wild animals from their natural habitats.

The notion that mining operations at Jena have increased air pollution levels due to dust and emissions from machinery had a mean score of 3.06 and a standard deviation of 1.80. Since the mean score was more than 2.5, these results indicated that most of the respondents agreed with the notion that mining operations at Jena have increased air pollution levels due to dust and emissions from machinery.

The statement that chemicals used in gold extraction have polluted nearby water sources, negatively impacting wildlife and vegetation had a mean score of 3.11 and a standard deviation of 1.58. This indicated that the majority of the respondents were in agreement with the notion that chemicals used in gold extraction have polluted nearby water sources, negatively impacting wildlife and vegetation.

The notion that mining process has led to soil erosion and reduced soil fertility in the affected areas had a mean score of 3.22 and a standard deviation of 1.43. This indicated that most of the questionnaire respondents agreed that mining process has led to soil erosion and reduced soil fertility in the affected areas. The standard deviation was less 3 showing that the mean score fairly represented the perceptions of most of the respondents.

In interviews conducted with key informants from EMA, it was revealed that Jena gold mining activities in Silobela have had several significant environmental implications, particularly on local trees, wildlife, and atmospheric conditions. The following summarizes the key findings:

All three EMA officials acknowledged the substantial deforestation caused by mining activities. According to one interviewee, "*The mining operations have led to the clearing of large tracts of forests to make way for extraction processes and infrastructure. This not only disrupts local ecosystems but also exacerbates soil erosion*". The loss of vegetation, particularly indigenous trees, has led to a reduction in biodiversity. Another interviewee highlighted the concern, saying, "*There are few reforestation efforts to compensate for the loss of trees, which is a major environmental concern. The clearing of land is often not controlled, and as a result, we see a disruption in the local climate and a loss of habitats for wildlife*".
The interviews also revealed that mining activities have also posed significant threats to wild animals in the area. One of the interviewees shared that,

"*Wildlife is greatly affected by the disruption of their natural habitats. Animals such as antelope, zebra, and various bird species rely on these forests for food and shelter. The mining sites often displace these animals, leading them to venture into more populated areas, which increases the risk of human-wildlife conflict*".

This was also echoed by another interviewee who stated that, "*We've seen a reduction in the population of certain species that are vital for the local ecosystem. The encroachment into animal territories is a growing concern that needs urgent attention*".

In addition it was mentioned that the mining operations have had adverse effects on the atmosphere and air quality in Silobela. In line with one interviewee, "*Dust generated from the mining processes, including excavation and transportation of materials, contributes to poor air quality. There are reports of increased respiratory illnesses among local residents as a result*". Additionally, one key informant emphasized, "*The atmospheric pollution is compounded by the burning of fuel and emissions from mining equipment. These activities lead to the release of particulate matter into the air, contributing to global warming and altering the local climate*".

In summary, while Jena gold mining operations provide economic opportunities, the environmental costs are significant. The interviews highlight the need for stronger regulatory enforcement and more effective mitigation measures to protect trees, wildlife, and air quality in Silobela.

4.5 Benefits of Jena gold mining activities to the local residents in Silobela

The questionnaire respondents were further asked how far they agreed to a number of statements concerning the benefits of Jena gold mining activities to the local residents in Silobela. The results in Table 4.6 below show the mean values and standard deviation calculated from their responses.

Table 4.6: Benefits of Jena gold mining activities to the local residents in Silobela

	Mean	**St. deviation**

Jena gold mining activities have significantly improved employment opportunities for local residents.	3.34	1.35
The mining activities have contributed to the development of infrastructure such as roads, schools, and healthcare facilities in the surrounding communities.	2.19	1.14
Local businesses and entrepreneurs have benefited from increased economic activity due to Jena gold mining operations.	4.32	1.54
Jena gold mining company actively supports community development projects such as education, healthcare, and social welfare programs.	3.26	1.59
The mining company effectively manages its environmental impact, ensuring that local residents benefit from a clean and safe environment.	2.38	1.97

Source: Questionnaire data

The findings in Table 4.6 indicate that the notion that Jena gold mining activities have significantly improved employment opportunities for local residents had a mean score of 3.34 and a standard deviation of 1.35. This indicated that the majority of the respondents were in agreement with the notion that Jena gold mining activities have significantly improved employment opportunities for local residents.

The statement that the mining activities have contributed to the development of infrastructure such as roads, schools, and healthcare facilities in the surrounding communities had a mean score of 2.19 and a standard deviation of 1.14. This indicated that most of the questionnaire

respondents disagreed that the mining activities have contributed to the development of infrastructure such as roads, schools, and healthcare facilities in the surrounding communities.

The notion that local businesses and entrepreneurs have benefited from increased economic activity due to Jena gold mining operations had a mean score of 4.32 and a standard deviation of 1.54. Since the mean score was more than 2.5, these results indicated that most of the respondents were in agreement with the notion that local businesses and entrepreneurs have benefited from increased economic activity due to Jena gold mining operations.

The notion that Jena gold mining company actively supports community development projects such as education, healthcare, and social welfare programs had a mean score of 3.26 and a standard deviation of 1.59. This meant that the majority of the respondents agreed with the notion that Jena gold mining company actively supports community development projects such as education, healthcare, and social welfare programs.

The notion that the mining company effectively manages its environmental impact, ensuring that local residents benefit from a clean and safe environment had a mean score of 2.38 and a standard deviation of 1.97. This shows that the majority of the respondents disagreed with the notion that the mining company effectively manages its environmental impact, ensuring that local residents benefit from a clean and safe environment.

Interviews with key informants from EMA further provided insights into the perceived benefits of Jena gold mining activities to the local residents in Silobela. While all respondents acknowledged certain economic benefits, concerns were raised regarding environmental sustainability and long-term community welfare.

The key informants highlighted that Jena gold mining has contributed to job creation, directly employing local residents and indirectly supporting small businesses. One informant noted:

"The mine has created employment opportunities for the local population, reducing the reliance on subsistence farming and informal sector activities. Many young people who would have migrated to cities in search of work have found stable employment within the mining sector".

Additionally, they pointed out that the increased economic activity has led to the growth of local businesses, including retail shops, transport services, and food vendors.

The interviews revealed that the mining company has played a role in infrastructure development within Silobela, albeit at a modest scale. A second informant stated:

"We have seen some improvements in road networks around the mining area, which has made it easier for residents to travel and conduct business. The mine has also supported local schools with learning materials and made occasional donations to the clinic".

However, the informants acknowledged that while there were some corporate social responsibility (CSR) initiatives, they remained insufficient compared to the scale of mining operations.

Despite economic benefits, environmental concerns were a recurring theme in the interviews. The third informant raised concerns about land degradation and pollution:

"While the mine contributes to local economic development, the environmental impact cannot be ignored. There have been reports of deforestation, land degradation, and water contamination due to mining activities. If not properly managed, these environmental challenges could outweigh the short-term economic benefits".

The informants stressed the importance of sustainable mining practices to ensure long-term benefits for Silobela residents. They called for stronger enforcement of environmental regulations and more community engagement in environmental conservation efforts.

Overall, the interviews with EMA key informants revealed that while Jena gold mining has provided employment and some infrastructure development, concerns remain regarding environmental sustainability and the equitable distribution of benefits. The informants emphasised the need for a more structured approach to corporate social responsibility and stricter environmental management to ensure that local residents benefit in a sustainable manner.

4.6 Discussion

The results of the study indicated significant concern among local residents regarding the negative impacts of Jena gold mining activities on water quality. Respondents overwhelmingly agreed that mining operations contribute to water contamination, with high levels of toxic substances, including heavy metals and mercury, polluting nearby rivers and underground water sources (Chikozho, 2020; Simatele et al., 2022). Interviewees from the Environmental Management Agency echoed these concerns, with one noting that local residents have reported an increase in waterborne diseases linked to contamination from the mining activities (Chikozho, 2021). Furthermore, mining operations are not only responsible for chemical contamination but also for water shortages, as large amounts of water are consumed for industrial purposes, leaving local communities with inadequate supplies (Moyo & Makombe, 2023). The study thus calls for stricter regulatory measures and better compliance with environmental guidelines to mitigate the negative impacts on local water sources (Gundani, 2021).

In addition, the findings showed severe environmental consequences of Jena gold mining activities in Silobela, with notable effects on deforestation, wildlife displacement, and air quality. A number of scholars have discussed similar trends in mining regions worldwide. Deforestation, driven by mining, has been widely documented as a major environmental concern, as it leads to habitat destruction and reduced biodiversity (Mines, 2020; Kaimowitz

et al., 2021). This study aligns with such findings, where mining activities have led to the loss of indigenous trees and habitats, disrupting local ecosystems (Bebbington et al., 2019). Additionally, wildlife displacement is a common issue associated with mining operations, as the destruction of natural habitats forces animals into less hospitable areas, increasing the risk of human-wildlife conflict (Heikkinen et al., 2020). In Silobela, local animals such as antelope and zebra are displaced due to habitat disruption caused by mining activities, reflecting global concerns about the ecological impact of mining (Murray et al., 2018). It was also indicated that mining activities in Silobela have also contributed to air pollution, with dust and emissions from machinery deteriorating air quality. Such impacts are well-documented in mining regions, where particulate matter and gaseous emissions from mining processes contribute to respiratory issues among residents (Akpinar-Ferrand et al., 2019; Zaveri et al., 2022).

The research findings went on to suggest that Jena gold mining activities have had a mixed impact on the local community in Silobela. On one hand, the majority of respondents agreed that the mining activities have improved employment opportunities for local residents and contributed to the growth of local businesses. This is in line with Hilson (2019), who highlights the potential economic benefits of mining activities, such as job creation and local economic growth. This is also concurred by McMahon (2018), who notes that mining activities can contribute to local economic development. On the other hand, the findings also suggest that the mining activities have had a negative impact on the environment, with respondents disagreeing that the mining company effectively manages its environmental impact. This is consistent with Mabhena (2020), who reviews the environmental impacts of mining in Zimbabwe and notes that mining activities can lead to environmental degradation and pollution. This is also supported by Nyabeze (2019), who highlights the need for environmental sustainability in the mining sector. The findings also suggest that the mining company's corporate social responsibility initiatives have been insufficient, with respondents acknowledging that while

there have been some improvements in infrastructure development, these have been modest and insufficient compared to the scale of mining operations. This is in line with Kemp (2018), who reviews the literature on CSR in the mining industry and notes that CSR initiatives are often insufficient and ineffective. This is also concurred by Owen (2020), who highlights the need for more structured and sustainable approaches to CSR in the mining sector. In a nutshell, the findings suggest that while Jena gold mining activities have provided some economic benefits to the local community, these benefits have been accompanied by significant environmental and social costs.

4.7 Summary

The prime purpose of the chapter was present the data for the study, analyse the data and interpret the study findings. The study explored the impacts of Jena gold mining activities in Silobela, focusing on water sources, environmental degradation, and local benefits. The findings revealed significant concerns about water quality, with mining operations contaminating nearby rivers and underground water with toxic chemicals like mercury and cyanide. Local water shortages were also exacerbated by excessive water consumption by the mine. Regarding environmental impacts, deforestation, wildlife displacement, and increased air pollution were highlighted. Mining activities led to habitat destruction, increased soil erosion, and respiratory problems due to dust and emissions. Despite these challenges, the study found that mining had positively impacted employment and local businesses, providing new job opportunities and stimulating economic growth. However, the community reported limited infrastructure development and inadequate environmental management efforts. The chapter closed with a discussion of the study findings in the context of related literature.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND AREAS FOR FURTHER RESEARCH

5.1 Introduction

The prime purpose of this chapter is to summarise the research findings, derive conclusions and proffer recommendations for key stakeholders. It starts with the summary of the results of the study. The chapter goes on to come up with conclusions pertaining to the study objectives. After that the chapter presents the recommendations of the study. It further recommends areas of further research in consolidating and extending knowledge on the research phenomenon.

5.2 Summary

The research aimed to explore the impacts of Jena gold mining activities in Silobela, focusing on three key areas: the effects on cleaner sources of water, the implications for trees, wild animals, and the atmosphere, and the benefits of the mining activities to local residents. The study collected data through questionnaires from community members and interviews with key informants from the Environmental Management Agency.

5.2.1 Impacts of Jena gold mining activities on water sources

One of the critical concerns raised in the study was the impact of mining activities on water sources in Silobela. The results revealed that the majority of respondents agreed that mining operations had significantly reduced the quality of water sources in the surrounding areas. The study found that mining operations contribute to the pollution of rivers and underground water sources, with chemicals used in gold extraction, such as mercury and cyanide, contaminating nearby water bodies. Water sources near mining sites were reported to contain high levels of

toxic substances that pose risks to both human and environmental health. Local communities also experience frequent water shortages due to excessive water consumption by mining activities, further exacerbating the problem. However, the study indicated that efforts by the mining company to mitigate water contamination were widely seen as ineffective.

Interviews with EMA officials reinforced these concerns. They highlighted that mining operations have led to increased sedimentation in rivers, making water unsafe for consumption. They also noted that water quality declines, particularly after heavy rains, as runoff carries mining pollutants into local rivers. Additionally, EMA officials pointed out that enforcement of environmental safeguards remains weak, with mining companies failing to fully comply with existing regulations. The findings underscore the need for improved environmental management practices and stricter regulatory enforcement to ensure the protection of water sources for local communities. Without proper intervention, the long-term consequences of water pollution may lead to severe health and ecological risks for Silobela residents.

5.2.2 Implications of Jena gold mining on trees, wildlife, and the atmosphere

The study further examined the broader environmental impacts of Jena gold mining, particularly concerning deforestation, wildlife displacement, and air pollution. The findings showed that the majority of respondents believed that mining operations have led to significant deforestation in the surrounding area. Large tracts of forests have been cleared to make way for mining activities and infrastructure, leading to habitat destruction and increased soil erosion. The loss of vegetation has also contributed to reduced biodiversity, with few efforts being made to restore the destroyed forested areas. Wildlife displacement was another major concern. Respondents agreed that mining activities have disrupted the natural habitats of various animal species, forcing them to migrate to other areas. This displacement has resulted in increased human-wildlife conflicts, as animals such as antelope and zebra venture into

populated regions in search of food and shelter. The reduction in the population of certain species was also noted as a major ecological concern.

The research findings also indicated that mining activities have increased air pollution levels due to dust from excavation, transportation of materials, and emissions from heavy machinery. Many respondents reported experiencing respiratory problems, which they attributed to prolonged exposure to mining dust and emissions. EMA officials confirmed these concerns, pointing out that dust and chemical emissions contribute to deteriorating air quality. They also highlighted that fuel combustion from mining equipment releases pollutants that contribute to global warming and local climate changes. The combined effects of deforestation, habitat destruction, and atmospheric pollution demonstrate that mining activities pose significant environmental risks. The study suggests the need for enhanced conservation measures, such as reforestation programs, sustainable land use policies, and stricter emissions controls to mitigate these environmental damages.

5.2.3 Benefits of Jena gold mining activities to local residents

Despite the environmental concerns, the study also examined the perceived benefits of Jena gold mining activities to the local residents. The results showed that the majority of respondents agreed that mining activities have significantly improved employment opportunities in Silobela. The mining sector has provided direct and indirect employment, reducing dependence on subsistence farming and informal sector activities. Many young people, who would have otherwise migrated to urban areas for job opportunities, have found stable employment within the mining sector. Additionally, the study found that local businesses and entrepreneurs have benefited from the increased economic activity due to mining operations. The presence of the mining company has stimulated economic growth by supporting small businesses such as retail shops, transport services, and food vendors. These businesses have capitalized on the economic

opportunities created by the influx of workers and increased financial circulation within the community.

However, the study found limited evidence to suggest that Jena gold mining activities have significantly contributed to infrastructure development in the surrounding communities. Most respondents disagreed with the notion that mining operations have led to substantial improvements in roads, schools, and healthcare facilities. While there were reports of minor infrastructure developments, such as road maintenance and occasional donations to schools and clinics, these efforts were deemed insufficient in addressing the broader developmental needs of the community. Interviews with EMA officials further reinforced these findings. The informants noted that while the mining company had made some contributions to infrastructure and community projects, these efforts were not proportionate to the scale of mining operations and their economic benefits. They emphasized that corporate social responsibility initiatives should be more structured and substantial to ensure long-term community development.

Another critical issue raised in the study was the mining company's approach to environmental management. Most respondents disagreed with the notion that the mining company effectively mitigates environmental risks to ensure a clean and safe environment for local residents. Concerns about water pollution, land degradation, and deforestation highlighted a lack of adequate environmental protection measures. EMA officials stressed the importance of striking a balance between economic benefits and environmental sustainability. They called for stronger enforcement of environmental regulations and increased community engagement in conservation efforts. Without proper mitigation measures, the long-term environmental costs could outweigh the short-term economic benefits, leading to further challenges for local communities.

5.3 Conclusion

The study aimed to assess the impacts and benefits of Jena gold mining activities in Silobela, focusing on three key objectives: the effects on cleaner water sources, the implications for trees, wild animals, and the atmosphere, and the benefits to local residents. The findings provided valuable insights into the environmental and socio-economic consequences of mining operations in the region, enabling conclusions to be made.

In this regard, the study concluded that Jena gold mining activities have significantly affected the quality of water sources in Silobela. Mining operations contribute to water pollution through the release of heavy metals such as mercury and cyanide, which seep into rivers and underground water sources. This contamination poses risks to human health and aquatic ecosystems. Additionally, excessive water consumption by mining operations has led to frequent water shortages in the community, further limiting access to clean and safe drinking water. Despite efforts by the mining company to mitigate water contamination, these measures were deemed inadequate by the majority of respondents. The study emphasises the need for stronger environmental regulations and improved wastewater treatment methods to safeguard water sources for local communities.

The research also concluded that mining activities have contributed to extensive deforestation, resulting in the destruction of natural habitats and a reduction in biodiversity. The clearing of forests for mining operations has exacerbated soil erosion, making land unsuitable for vegetation growth. Additionally, the displacement of wild animals was identified as a significant concern, as many species have been forced to migrate to other areas, leading to increased human-wildlife conflicts. Air pollution caused by mining activities, including dust from excavation and emissions from machinery, has also deteriorated air quality, with reported cases of respiratory illnesses among residents. The study underscored the need for sustainable

mining practices, reforestation programs, and stricter emissions controls to minimize these environmental impacts.

On the other hand, despite the environmental challenges, the study found that Jena gold mining activities have provided economic benefits to the local community. Employment opportunities have increased, reducing reliance on informal sector activities and subsistence farming. Additionally, local businesses have experienced growth due to the economic activities generated by the mining sector. However, the contribution of mining to infrastructure development, such as roads, schools, and healthcare facilities, was found to be minimal. Respondents indicated that corporate social responsibility efforts by the mining company were insufficient compared to the scale of operations. The study thus concluded that while mining offers economic opportunities, these benefits must be complemented by more structured community development initiatives and better environmental stewardship to ensure long-term sustainability.

5.4 Recommendations

The research came up with recommendations for reducing the harmful environmental effects of gold mining and improving benefits to local communities in Zimbabwe. To policymakers, it recommended that they should;

- Strengthen environmental regulations. Policymakers should enforce stricter mining regulations, including mandatory environmental impact assessments before issuing mining permits, and impose penalties for non-compliance.
- Promote sustainable mining practices. Develop policies that incentivize eco-friendly mining methods, such as mercury-free gold extraction and improved waste management.

- Require mining companies to allocate a percentage of their revenue to community development projects, such as clean water supply, schools, and healthcare facilities.
- Increase monitoring and enforcement. Establish independent monitoring bodies to oversee mining operations, ensure compliance with environmental standards, and hold violators accountable.

It also recommended that the Environmental Management Agency should;

- Conduct frequent and unannounced environmental audits on mining companies to ensure adherence to waste disposal, water protection, and air quality standards.
- Educate local communities about the environmental risks of mining and ways to hold companies accountable for pollution and deforestation.
- Require mining companies to restore mined-out land by planting indigenous trees and rehabilitating degraded landscapes.
- Work with stakeholders to ensure mining companies implement proper water treatment systems and reduce water consumption to prevent shortages in local communities.

To gold mining companies, the study recommended that they should;

- Adopt Environmentally Friendly Technologies. Invest in sustainable gold extraction methods that minimise toxic chemical use and reduce pollution.
- Improve Waste Management Practices. Implement safer disposal methods for mining waste, such as tailings dams, to prevent contamination of rivers and groundwater.
- Expand Community Development Initiatives. Increase investments in local infrastructure, including roads, schools, healthcare facilities, and clean water supply, to improve residents' quality of life.

- Enhance Stakeholder Engagement. Regularly consult with local communities, EMA, and policymakers to ensure mining operations align with environmental and social expectations.

To local communities, the research recommended that they should;

- Work with environmental organisations to demand accountability from mining companies and report any observed pollution or land degradation.
- Explore sustainable economic activities such as agriculture, eco-tourism, and artisanal mining using safer techniques to reduce dependence on large-scale mining.
- Collaborate with EMA and researchers to conduct community-based environmental monitoring and report hazardous pollution levels.
- Advocate for fair distribution of mining revenues, ensuring that a portion of profits is reinvested into local community projects.

5.5 Areas for further research

While existing studies have examined its immediate impacts, further research is needed to assess long-term environmental consequences, alternative livelihoods, and regulatory effectiveness. One critical area for further research is the long-term environmental impact of gold mining. Future studies should investigate the lasting effects of mining activities on soil fertility, biodiversity, and water quality. Such research would provide valuable insights into whether current land rehabilitation efforts are effective in restoring degraded ecosystems. Another important avenue for research is community perceptions and alternative livelihoods. Research should explore how local communities perceive the trade-off between economic benefits and ecological damage. Additionally, studies should identify and promote sustainable alternative livelihoods such as eco-tourism, sustainable agriculture, and safer artisanal mining practices to reduce dependency on large-scale mining operations. Lastly, further research

should assess the effectiveness of environmental regulations in mitigating mining-related harm. Such studies could highlight gaps in regulation and recommend improvements to ensure that mining companies adhere to the best environmental practices while contributing more meaningfully to community development.

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ANNEXURE 1: QUESTIONNAIRE

QUESTIONNAIRE

Please read the instructions below before responding to the questions in these questionnaires.

Instructions

1) Please do not write your name on the questionnaire. This is to protect the confidentiality of your responses.

2) Be free to air out your true views and perspectives because this study is for academic purposes only.

3) Indicate your responses by writing an X or writing on the spaces provided.

4) Please try as much as possible to respond to all questions on the questionnaire.

Section A: Demographic information

1. Gender [ ] Male [ ] Female

2. Age [ ] 18-30 [ ] 30-40 years
   [ ] 40-50 years [ ] Above 50 years

3. Level of education
   [ ] O/A level [ ] Diploma/ Certificate
   [ ] Degree [ ] Postgraduate
   [ ] Other……

4. Period living in Silobela [ ] 5 years and below [ ] 5-10 years
   [ ] 10-15 years [ ] 15-20 years
   [ ] Above years

Section B: Impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents in Silobela

How far do you agree to the following statements about the impacts of Jena gold mining activities towards cleaner sources of water which are used by the residents in Silobela? Use the following scale

Key: SA= Strongly agree, A= Agree, U= Neutral, D= Disagree, SD= Strongly disagree

		SA	**A**	**N**	**D**	**SD**
5	Mining activities have significantly reduced the quality of water sources in the surrounding areas.					

6	Mining operations contribute to the pollution of rivers and underground water sources.					
7	Water sources near mining sites contain high levels of toxic substances that pose risks to human and environmental health.					
8	Local communities experience frequent water shortages due to excessive water consumption by mining activities.					
9	Efforts by mining companies to mitigate water contamination are effective in protecting local water sources.					

Section C: Implications of Jena gold mining operations to the trees, wild animals and the atmosphere in Silobela

How far do you agree to the following statements about implications of Jena gold mining operations to the trees, wild animals and the atmosphere in Silobela?

		SA	**A**	**N**	**D**	**SD**
16	Jena gold mining operations have led to significant deforestation in the surrounding area.					
17	The mining activities have contributed to the displacement of wild animals from their natural habitats.					

18	Mining operations at Jena have increased air pollution levels due to dust and emissions from machinery					
19	Chemicals used in gold extraction have polluted nearby water sources, negatively impacting wildlife and vegetation.					
20	The mining process has led to soil erosion and reduced soil fertility in the affected areas.					
23	Employees at my organisation are empowered to contribute to results					

Section D: Benefits of Jena gold mining activities to the local residents in Silobela

How far do you agree to the following statements about the benefits of Jena gold mining activities to the local residents in Silobela?

		SA	**A**	**N**	**D**	**SD**
26	Jena gold mining activities have significantly improved employment opportunities for local residents.					
27	The mining activities have contributed to the development of infrastructure such as roads, schools, and healthcare facilities in the surrounding communities.					

28	Local businesses and entrepreneurs have benefited from increased economic activity due to Jena gold mining operations.					
29	Jena gold mining company actively supports community development projects such as education, healthcare, and social welfare programs.					
30	The mining company effectively manages its environmental impact, ensuring that local residents benefit from a clean and safe environment.					

Thank you for your cooperation

ANNEXURE 2: INTERVIEW GUIDE

Interview Questions for key informants

1. What are the negative effects of Jena gold mining activities towards cleaner sources of water?
2. How is Jena gold mine affecting the trees, wild animals and the atmosphere at large?
3. What are the benefits of the mining operations to the local people?
4. What changes have you noticed in the environment since mining began?
5. How has mining impacted local services, such as health care and education?
6. What ideas can be developed into policies that protect the Silobela environment?

Merit Chimwaza

77/5 Mbizo Kwekwe

0773979881

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28March 2025

The Mining Manager

Jena Gold Mine

P.Bag 8003

Kwekwe District

RE:ASKING FOR PERMISSION TO CARRY OUT A RESEARCH AT YOUR MINE.

Dear Sir/Madam

I hereby write this letter to the mining manager of Jena Gold Mine , seeking approval to conduct an educational research based on the environmental impacts of mining activities in Zimbabwe a case of Jena Gold Mine in kwekwe.

I am lady aged 23 ,doing my final year in peace and governance at Bindura University of Science Education. As stated above ,this research will be part of final year project and it will contribute positively to my studies and will improve my research skills. It will explore the negative and positive impacts of mining activities to the community as a whole and give recommendations where necessary .

I will be honoured if you grant me the permission to carry out my research.

With this letter I have attached a consent form from the University.

Yours Sincerely

Merit Chimwaza

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SOCIAL SCIENCES AND HUMANITIES

DEPARTMENT OF PEACE AND GOVERNANCE

28 November 2024

TO WHOM IT MAY CONCERN

RE: REQUEST TO UNDERTAKE RESEARCH IN YOUR ORGANISATION

This serves to introduce the bearer, MERIT CHIMWAZA, Student Registration Number B2110723, who is a HBSC PEACE AND GOVERNANCE student at Bindura University of Science Education and is carrying out a research project in your area/institution.

May you please assist the student to access data relev

interviews as part of a data collection process.

Yours respectfully

J.KUREBWA (DR)
Acting Chairperson

BINDURA UNIVERSITY OF SCIENCE EDUCATION
PEACE & GOVERNANCE
28 NOV 2024
FACULTY OF SCIENCE EDUCATION
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28 MAR 2025
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