BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SOCIAL SCIENCE AND HUMANITIES

The Effects of Artisinal Miners and Small Scale Miners on the Environment of Kitsiyatota.

By

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A Dissertation Submitted to the Department of Peace and Governance in Partial Fulfilment for the Requirements for the Bachelor of Science Honours Degree in Peace and Governance**.**

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ABSTRACT

Artisanal and small-scale mining (ASM) activities have a considerable negative impact on the environment, particularly in the Kitsiyatota district of Bindura. This research seeks to examine and comprehend the environmental and ecological consequences of these mining activities. It specifically investigates the severity of ASM's impacts on land usage, water sources, ecology, and air quality. The study also assesses the efficiency of current environmental rules and policies in mitigating these effects and proposes alternative policy and regulatory adjustments to lessen ASM's environmental for The study is organized around four main goals: to investigate the environmental effects of ASM, to assess the scope and severity of these effects, to identify the obstacles that artisanal gold miners confront, and to provide solutions to alleviate the environmental impacts. Key research concerns include defining the unique environmental effects of ASM, quantifying their severity, understanding the obstacles that miners confront, and investigating ways to reduce environmental damage. Print in Kitsiyatota. The study gives a complete picture of the environmental implications of ASM in Kitsiyatota using a combination of questionnaires, interviews with local stakeholders, and data analysis. The findings show severe land degradation, contamination of water sources, detrimental impacts on local biodiversity, and deterioration of air quality. The paper also identifies gaps in present environmental legislation and makes actionable recommendations for improving policy frameworks and enforcement mechanisms. In conclusion, this study emphasizes the critical need for appropriate environmental management practices and policy interventions to offset the negative consequences of ASM in Kitsiyatota, assuring sustainable mining practices and protecting the local ecology.

DECLARATION

I **B211075B** studying the Bachelor of Honors Degree in Peace and Governance am aware that plagiarism is a serious academic offence and that falsifying information is a breach of Community Development research ethics therefore I truly declare that:

1. The dissertation report titled: The Effects of Artisinal Miners and Small Scale on the environment of Kitsiyatota.

2. The research has followed all ethics in Peace and Governance

3. I grant Bindura University of Science Education to use the research for educational purposes.

Student's name.....Signature.....…

Date: 30 March 2025

Dr Muchemwa Supervisor Signature

Date: 22 October 2025

Chairperson of PG Dr Kurebwa Signature……..

Date:

DEDICATION

I dedicate this work to my parents, whose continuous support and encouragement enabled the project's accomplishment, as well as my siblings Tariro, Tanatswa and Taziva Mupesa. I express my heartfelt gratitude to my cherished family for their love, encouragement, support, sacrifice, and inspiration in allowing me to follow my aspirations. My God, bless them all.

To my fellow students and friends, whose cooperation and camaraderie have made this trip pleasurable and rewarding. I hope that my brothers may find motivation in this work as they pursue their academic goals.

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This study was a collaborative effort, and I am grateful to everyone who contributed to its success.

LIST OF ACRONYMS AND ABBREVIATIONS

ASM	Artisanal and Small Scale Miners
EMA	Environmental Management Agency
EU	European Union
HRC	Human Rights Commission Zimbabwe
MLG	Ministry of Local Government
OPC	Office of the President and Cabinet
NGO	Non-Governmental Organization
PSC	Public Service Commission Zimbabwe
SADC	Southern African Development Community
UN	United Nations

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CHAPTER 1

1.0 INTRODUCTION

1.1 Background of the study

The International Institute for Environment and Development (IIED) defines Artisanal mining as a mostly informal, labor-intensive activity that uses simple tools and methods to extract minerals, primarily gold, and diamonds. The Institute further notes that artisanal mining is a small-scale, manual, low-tech, localized, and often informal form of mining. Artisanal mining is typically carried out by individual miners or small groups of people using simple tools and equipment. This type of mining is often considered a more environmentally friendly and sustainable form of mining, as it has a smaller environmental footprint than industrial mining. However, there are also environmental risks associated with artisanal mining, such as the use of mercury and other chemicals, and the disruption of the ecosystems.

Artisanal and small-scale mining (ASM) has become a major source of livelihood for many individuals globally, particularly in Zimbabwe and the Bindura region. Estimates suggest that between 40-100 million people are engaged in ASM worldwide, with the majority residing in developing countries. This includes not just miners, but also those working in support roles like processing and selling minerals. While precise figures are difficult to determine due to the informal and unregulated nature of much ASM activity, it is clear that this sector is a significant part of the global economy and plays a crucial role in the livelihoods of many communities, especially in rural areas of the developing world. A 2018 study by the World Gold Council found that ASM accounts for approximately 20% of global gold production and is an important income source for millions in developing countries. However, the same study also highlighted that the ASM sector faces significant environmental and social challenges that need to be addressed. In summary, the rise of artisanal and small-scale mining as a major livelihood

globally, including in Zimbabwe and Bindura, represents both an economic opportunity and a complex set of sustainability issues that require careful consideration and response.

While artisanal and small-scale mining, especially gold mining seems prevalent in many parts of the world, the activity is particularly dominant in Sub-Saharan Africa, South East Asia, and Latin America (Okyere, 2017). Furthermore, in countries like Ghana, Tanzania, and Peru where the activity is dominant, the sector plays crucial roles in the economies of these countries, while in some of the countries it accounts for 40% of total gold production. According to Okyere (2017), ASM is also significant in the Democratic Republic of Congo (DRC), Sierra Leone, and Colombia where the mining of diamonds, coltan, and coal is dominant contributing an important stake to their economies.

In Zimbabwe, artisanal and small-scale mining has emerged as a major economic driver. The sector contributes significantly to the economy, accounting for 10-15% of total gold production (Maunganidze, Chivenge, Akudugu, and Taigbenu, 2019). The economic crisis, significant unemployment, recurring droughts, regulations prohibiting ASM, and the gold rush are just a few of the factors that have contributed to the expansion of artisanal gold mining in Zimbabwe. The situation has been compounded by the economy's current woes, which include hyperinflation and severely low worker salaries report by the World Bank (2007) revealed that many households in Zimbabwe are now living well below the poverty threshold. Along with the soaring inflation rates at this time, many families are experiencing financial difficulties with the majority of people in low-income sectors having turned to artisanal gold mining thereby increasing the numbers of artisanal gold miners throughout the country.

While ASM has become a major source of income for many rural communities, providing employment and income-generating opportunities in Zimbabwe, the sector faces

several challenges, including lack of formalization, poor working conditions, and lack of access to finance and markets (Mauganidze et al, 2019). Most importantly, the sector is associated with negative environmental and social impacts, such as water pollution and deforestation or land degradation. However, due to economic hardships in Zimbabwe the majority of those people living in gold mineral-rich areas and alongside river banks, have adopted artisanal mining as their back-borne livelihood. In Bindura town, ASM activities have increased in recent years, raising concerns about their environmental impacts.

Gold is the most common mineral mined in Zimbabwe and ASM accounts for about 40% of the country's total gold production and is also a major source of livelihood with an estimated 80% of ASM workers living in rural areas. On the other hand, this has resulted in increased open lands in all areas rich in gold. From an environmental outlook, the act of artisanal mining has resulted in more damage to the environment due to for example disturbance of soil surfaces, deforestation, and contamination of water sources. However, these damages are driven by different factors including the significant factor that directly affects the expansion of ASM in several parts of Zimbabwe, particularly Kitsiyatota, and the severe unemployment rate of the nation. The economy of the country was in a condition of collapse back then, which caused several enterprises and industries to close, increasing unemployment. Numerous companies shut down as a result of the economic slump, according to Moss and Busse (2006), which led to the majority of workers losing their jobs. They quoted information stating that in 2008, Zimbabwe's jobless rate rose to 80%. People had no alternative but to choose artisanal smallscale gold mining as their main source of income to survive due to the extreme unemployment.

In many areas of Zimbabwe, including the study area of Kitsiyatota, droughts have emerged as a problem. Another reason for the emergence of ASM in Zimbabwe is thought to

be recurrent droughts. Many residents of Mashonaland Central and others from other regions turned to artisanal mining to help them feed their families in their ostensibly drought-stricken regions. According to Masiya et al. (2003), households have been forced to diversify into artisanal gold mining along rivers and in abandoned mines since subsistence agriculture has continued to diminish over the previous 10 years as a result of repeated droughts.

However, despite the income-generating effects of the mining activity involving miners, several negative effects on the natural environment have become inevitable. For example, the rapid expansion of ASM in Bindura, Zimbabwe has raised concerns about its impacts on the environmental impacts like the formation of gullies, land degradation, and deforestation. According to the World Health Organisation (2021), Mercury and cyanide, used in ASM to extract gold, have polluted the Mazowe River, which flows through the region and is relied upon for drinking water and irrigation. The contamination of the Mazowe River has had a significant impact on the health and well-being of the local communities. Thus, this current study aims to assess the environmental effects arising from the small-scale artisanal mining activities at Kitsiyatota in Bindura district.

In addition to the economic and livelihood factors driving the growth of artisanal and smallscale gold mining (ASGM) in Zimbabwe, legislation and government policies have also played a significant role. Researchers have noted that over the past decade, new government policies through the Ministry of Small and Medium Enterprises have encouraged the formalization of ASGM operations by supporting artisanal miners in registering their claims and engaging in legal mining activities. This policy shift has contributed to the expansion of ASGM in many areas of Zimbabwe, including Kitsiyatota in Bindura. Since the early 2000s, Zimbabwe has experienced a liberalization of mining activities and increased indigenization of

the sector, which has enabled more individuals to enter small-scale gold mining. Estimates suggest there are over 300,000 unregistered, informal gold mines in the country, in addition to more than 20,000 registered claims, with only around 10% actively operating.

While the growth of ASGM has provided income and employment opportunities for many households, it has also created significant environmental problems in areas like Kitsiyatota. The crude mining techniques used by artisanal miners have led to issues such as pollution, land degradation, soil erosion, and the drying up of rivers and water bodies due to siltation. These environmental impacts pose risks to the health and well-being of local communities.

In summary, the interplay of government policies encouraging the formalization of ASGM, alongside the broader liberalization of the mining sector in Zimbabwe, have been important drivers of the expansion of artisanal and small-scale gold mining in the country, including in the Bindura region. However, this growth has come at a cost, with substantial environmental and public health challenges needing to be addressed.

Land degradation is also another impact of ASM at Kitsiyatota. Land deterioration is brought on by artisanal gold miners' excavations. In addition to ruining arable land for farming, artisanal gold miners also cut down forests and dug several trenches. Another negative impact of artisanal small-scale gold mining on the environment is pollution. Air pollution, water contamination, land pollution, and noise pollution are the four main types of pollution brought on by artisanal mining.

All artisanal miners employ cyanide and mercury in the processes of amalgamating gold, which contaminates surface water on the surface of water systems (dams and rivers) as

well as underground water. The burning of mercury-gold amalgam by artisanal miners in open areas leads to the release of mercury into the atmosphere, causing air pollution. This air pollution can have detrimental health impacts, including the development of respiratory conditions such as bronchitis. Due to artisanal miners' inadequate waste management practices and noise pollution brought on by explosives and stone threshing stamps, which scared off some fauna to quieter places, land contamination grew severe. Thus, this study seeks to assess the environmental effects of artisanal mining particularly at KitsiYatota, Bindura, one of the areas where artisanal mining is predominant in Zimbabwe.

dura's environment, especially in KistiYatota.

1.2 PURPOSE OF THE STUDY

To assess and understand the adverse environmental and ecological impacts posed by artisanal mining at KitsiYatota in Bindura.

1.3 STATEMENT OF THE PROBLEM

While there has been a rash for the yellow metal it seems the local people are either aware or unaware of the damage they are causing to the environment. Due to economic hardships and unemployment in the country, the local people have had no option but to engage in illegal mining activities. Besides damage to the environment, many unsuspecting artisanal miners have also died of Health-related diseases due to illegal mining activities. Nonetheless, there is debate about whether the socioeconomic advantages of artisanal and small-scale gold mining exceed its obtrusively detrimental environmental effects, as shown by several widely conducted studies. There is a growing interest in the various environmental and social consequences associated with small-scale and artisanal mining, which leads to the need to look

into the effects of these activities. In Bindura, ASM has become so prevalent that residents are concerned about houses and structures collapsing as a result of mining operations at Kitsi Yatota, the site of the former Globe and Phoenix mine, or GMP. Consequently, the goal of the study is to appraise and analyze the effects that small-scale and artisanal mining operations have on Bindura.

1.4 RESEARCH OBJECTIVES

1. To examine the environmental effects of Artisanal mining and Small-Scale mining at Kitsiyatota in Bindura.
2. To evaluate the extent and severity of the effects of artisanal mining on the environment at Kitsiyatota in Bindura.
3. To examine the challenges faced by artisanal gold miners at Kitsiyatota in Bindura.
4. To propose possible measures or strategies for reducing the effects of artisanal mining on the environment at Kitsiyatota in Bindura.

1.5 RESEARCH QUESTIONS

1. What are the environmental effects of Artisanal mining and Small-Scale mining at Kitsiyatota in Bindura?
2. What is the extent and severity of the effects of artisanal mining on the environment?
3. What challenges are faced by artisanal gold miners at Kitsiyatota in Bindura?
4. What can be done to reduce the effects of artisanal mining on the environment at Kitsiyatota in Bindura?

1.6ASSUMPTIONS OF THE STUDY

The study assumes that the selected sample population will cooperate and provide accurate and reliable information for credible results. The study also assumes the availability of resources including the time resources in conducting the project.

1.7 SIGNIFICANCE OF THE STUDY

The study's findings will assist the environmental regulatory authorities (EMA), the government, academics, the local authority (Bindura municipality), Bindura inhabitants, and artisanal and small-scale miners. An assessment of mining's environmental impact will be crucial in protecting the environment, whether socially or physically. This study will assist the community in learning about the hidden environmental implications of artisanal mining. This will undoubtedly assist authorities, including the Environmental Management Agency (EMA), in implementing feasible measures to mitigate the negative impacts. The study will also help in sustaining the purpose of the sustainable development goals (SDGs) by facilitating sustainable small-scale mining practices.

Thus, the study will add value to the academic society, policy, and decision-making processes. To the policymakers, the study will provide evidence-based recommendations for policymakers on how to address the environmental challenges associated with ASM. This could help to improve environmental management and protection in Bindura and other areas affected by ASM. The study will also provide insights into the spatial patterns of environmental degradation caused by ASM, which can help planners develop strategies for sustainable land use in areas affected by ASM. Therefore the study will bring insight for the Development of policies and regulations to control and monitor the use of chemicals and waste management in ASM operations, Develop guidelines for sustainable land use and reclamation

of land affected by ASM, Develop strategies to raise awareness and build capacity among local communities and ASM operators on the environmental impacts of ASM and Implement projects to rehabilitate and restore degraded land and water resources in areas affected by ASM.

For educationists, the study will provide insights into how environmental education can be used to address the environmental challenges associated with ASM. The findings of the study can be used to develop curricula and educational materials on environmental sustainability for primary and secondary schools in areas affected by ASM. This could help to raise awareness among students and their families about the environmental impacts of ASM and encourage responsible mining practices. Finally, for researchers, the study will provide valuable data and information on the environmental effects of ASM in Bindura, which can be used to inform future research on this topic. The findings can also be used to generate new research questions and hypotheses related to environmental sustainability and ASM. For academics, the study will contribute to the body of knowledge on sustainable development and environmental management and can be used as a case study for teaching and training in these fields.

1.8 DELIMITATIONS OF THE STUDY

The study is confined to the boundaries and population of KitsiYatota mining claims formerly Globe and Phoenix or GMP Mine in Bindura. Bindura is the provincial capital of Mashonaland Central, the northern province of Zimbabwe. Bindura is 87km North of Harare. Kitsi Yatota is a gold-infested area that was abandoned by Globe and Phoenix Mine and was

left exposed to artisanal and small-scale mining activities. The mining area is right is located between Freda Rebecca Mie and the industrial area of Bindura. The focus of the study and its findings will not be generalized to other areas affected by ASM. The study is limited to the environmental impacts of ASM and will not address other issues such as the social or economic impacts.

1.9 LIMITATIONS OF THE STUDY

One of the difficulties the researcher encountered was that some small-scale, artisanal gold miners, particularly those engaged in illicit mining (gold panning), were afraid to reveal important information for fear of being detained by the police, who frequently visited their mines in casual clothing.

In addition to being arrested, they feared having their mines taken out of commission. One of the constraints was time, which was so limited that it made doing the research challenging. To aid in the gathering of data, the researcher had to enlist research assistants. Since the researcher was still enrolled in school, funding concerns prevented the research from being completed successfully.

1.10 DEFINITION OF TERMS

ARTISANAL MINING

It can be defined as a mining activity that is conducted by a group of individuals or families with minimal or no mechanization most often in the informal sector. Generally, most of the artisanal and small-scale miners are not officially registered (Hentschel et al, 2002).

GEOLOGY

According to the Oxford Dictionaries, geology is the study of the earth including its composition, structure, and history. This involves examining rocks, and minerals that make up the earth, as well as the physical processes that shape the planet over time.

ORGANISATION OF THE STUDY

The research study is divided into five chapters. The first chapter discusses the research topic, introduction, background of the study, problem statement, research objectives, research questions, hypothesis, and importance of the study, as well as the delimitations, limitations, and definitions of key terminology. Chapter 2 is a survey of the associated literature, in which several sources with relevant information are consulted. The theoretical and conceptual frameworks for the topic were used to form the basis of the investigation.

CHAPTER TWO

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter focuses on information presented by previous scholars or writers on related subjects. Therefore, this chapter centered on reviewing existing literature on the effects of artisanal and small-scale mining on the environment at Kitsiyatota in Bindura town. Thus, the chapter considers the theoretical and conceptual frameworks of the study and further interrogates previous studies carried out focussing on related variables. In other words, the chapter sought to review previous literature related to the subject being guided by the research questions.

2.2 Theoretical framework

2.2.1 The Political Economy Framework

The impacts of artisanal and small-scale mining could be examined using a variety of theoretical frameworks. The political economy framework, which emphasizes the political and economic aspects that affect the mining industry, is one possibility. The political economy framework, according to Moseley (2017), examines how social, political, and economic issues influence ASM in Zimbabwe. The paradigm specifically examines how the allocation of power and resources impacts the miner's capacity to function and receive a just reward for their labor. The framework, for instance, has an impact on state-level artisanal and small-scale mining, as the government exerts considerable control over the sector through licensing, environmental regulatory enforcement, and mining activity regulation. The distribution of mining profits is another function of the government, and it can have a big influence on the miners' quality of life. For instance, the government might decide to give large-scale mining corporations' interests precedence over small-scale miners'. The miners' capacity to make a living and enhance their standard of living may suffer as a result.

2.1.2 The social and environmental justice framework

The framework for social and environmental justice concentrates on the detrimental effects that small-scale and artisanal mining have on the environment and society in Zimbabwe, as well as the efforts of activists and local communities to solve these problems (Chin, 2011). It might, for instance, look into the human rights violations—like child labor, forced labor, and violence against local communities—that frequently take place in the mining sector. The framework can also examine the harm that mining does to the environment, including biodiversity loss, water pollution, and deforestation. The framework for social and environmental justice might also examine how activists and local communities have responded to these problems, including campaigns to promote change, hold mining firms responsible, and increase awareness. For instance, Chin's (2011) study examined the effects of ASM in Zimbabwe using the framework for social and environmental justice.

2.1.3 The Sustainable Livelihood Framework

The framework for sustainable livelihoods centers on the interconnected components—natural resources, social interactions, human capital, policies, and institutions—that are essential to attaining sustainable livelihoods (Scoones, Thompson, and Nelson, 2000). Using this theoretical framework, one may analyse how ASM affects nearby communities and ecosystems and find solutions to improve the sustainability of the mining sector. A method designed to assess and enhance the lives of the impoverished in developing nations is the sustainable livelihoods framework (Chambers and Constas, 2016). To achieve sustainable lives, the framework focuses on five capitals: natural, human, social, financial, and physical.

2.2 Conceptual framework

Artisanal small-scale mining (ASM), which includes practices like burning bushes, overstripping of overburden, deforestation, and the use of hazardous chemicals like mercury, hurts ecology. These negative consequences on the environment are the result of the wasteful methods used by artisanal small-scale miners to extract and process minerals, as well as their destructive mining activities. The study aimed to find out how small-scale and artisanal mining operations affected Kitsiyatota in Bindura. Below is a list of the independent and dependent variables.

2.2.1 Dependent variables

- Water and air quality
- Health
- Socio-economic and environmental effects
- Biodiversity
- Land use

2.2.2 Independent variables

- The quantity and types of pollutants
- Artisanal and small-scale miners
- The mining activities
- The social and economic impacts of mining
- Policies and regulations governing mining

2.4 Environmental impacts of Artisanal and Small scale mining at Kitsiyatota.

Mining is the process of removing valuable minerals from the Earth to obtain resources that cannot be grown or created artificially (Smith, 2019). More specifically, mining is used to obtain non-renewable resources including water, fossil fuels, and minerals. The four main forms of mining are underground, placer, in-situ, and surface mining. It is important to understand that the type of mining technique selected will depend on the usual resources being targeted for extraction, where the deposit is located on the Earth's surface or underground, and how well each method can extract the resource. Since each mining method has different implications for the environment and safety, legitimate mining enterprises are worried about these issues.

However, small-scale and artisanal mining has some negative effects on the environment. Small-scale and artisanal mining (ASM) businesses frequently lack legal protection, environmental controls, health and safety protocols, and financial stability for their employees. Unchecked use of ASM can lead to degradation of the environment, health problems in the community, and violations of human rights. According to studies, there are several adverse effects of ASM on the environment that are probably most concerning to those who watch the mining industry. River damage in alluvial regions, river siltation, erosion damage, deforestation, landscape devastation, risks from poorly constructed tailings dams, cyanide and mercury poisoning, and direct deposit of tailings and effluent into rivers are some of these impacts.

While it is true that small-scale miners typically cause more environmental harm than those employed by larger, contemporary mining companies, which have higher environmental costs per unit of output, it is also important to take into account the fact that these activities contribute to the national economy in terms of revenue (Wotruba et al., 1998; and McMahon

et al., 1999). This issue is exacerbated by a lack of knowledge, especially regarding the less obvious or longterm environmental effects of human activity. It is also exacerbated by a lack of information regarding practical ways to mitigate effects and clear incentives to modify research by Hentschel, Hruschka, and Priester (2003) showed that small-scale mining can have a significant negative impact on the environment as well as major health and safety repercussions for employees and nearby communities due to the subpar methods used in the extraction and processing of the target minerals.

Artisanal mining is allowed in Zimbabwe, although it is not allowed in many other nations. The consequent lack of an appropriate framework for laws and rules could prevent this industry from becoming formally recognized. Raising the standard of living for miners and the communities that depend on them is therefore difficult. Improvements in environmental performance are much more problematic when they are not formally recognized.

Deforestation, excessive over-stripping of overburden, bush burning, and the use of hazardous chemicals like mercury are just a few of the detrimental effects of artisanal small-scale mining (ASM) on the environment (Ncube-Phiri, Ncube, Mucherera, and Ncube, 2015). The artisanal and small-scale miners' wasteful methods of mineral extraction and processing, combined with their damaging mining practices, are to blame for these environmental effects. Artisanal mining has generally been seen as unlawful in some societies, although it has been legalized in Zimbabwe. According to a study by Chakuya, Munkuli, Mutema, and Gandiwa (2023), the conservation of biodiversity within protected areas is at risk due to illicit artisanal gold mining.

The multiple environmental effects of ASM, which include cyanide and mercury pollution, direct tailings and effluent disposal into rivers, hazards from poorly built tailings dams, river damage in alluvial areas, river siltation, erosion damage, deforestation, and landscape destruction, are what worry many mining observers the most. Small-scale miners cause greater environmental damage than those employed by modern mining companies, according to Wotruba et al. (1998), which raises the environmental cost per unit of output. Ncube-Phiri et al. (2015) state that massive overburden stripping and bush burning, which destroyed vast areas of land and river systems and generally disturbed the ecosystem, were features of the mining activities carried out by inexperienced and ill-equipped gold panners in Mzingwane District. According to the report, ASM is an ecological time bomb, and it is crucial to change Zimbabwe's institutional and legislative structures to support the growth of mining and sustainable use.

According to Bordo and Flandreau's 2003 research, artisanal miners' unsustainable operations often produce environmental disruptions that worsen resource bases, such as the communities surrounding mining sites. One of the disturbed areas in the research domain is the soil environment. Apart from the deliberate excavation of the soils during the gold mining process, the open land areas are rarely filled up after mining, which makes them habitats for dangerous creatures and reptiles, as well as potentially fatal locations for victims who fall in. Moreover, since underground mining—which is common in Zimbabwe—is associated with high water consumption and a falling water table, ASGM operations may make intercommunal conflicts worse due to water scarcity. Long-lasting droughts have driven some residents of the country's southern areas into Assisted Self-Gardening (ASGM); nevertheless, the sector's economic sustainability may be threatened by the increasing consequences of climate change,

such as heat stress and water scarcity. More importantly, the destruction of the ecology is a major source of concern.

Several potential economic benefits of artisanal and small-scale mining are lost through poor practice in mining, processing, and marketing the target minerals, and this problem is exacerbated by the absence of adequate legal frameworks and secure rights for miners and communities. Regulatory structures and institutions are also underdeveloped which also affects benefits from this sector. In most cases, artisanal and small-scale miners are often marginalized and there are very serious disputes with communities, government agencies, and large-scale mining interests. Problems associated with ASM such as child labor, access to health care, and education present major challenges to the government and regulatory authorities in countries where these activities take place, as well as to the wider development community.

Due to a lack of knowledge, expertise, or environmental awareness, small, medium, informal, legal, and illicit miners typically engage in ASM operations and exploit natural resources using primitive technologies and procedures (Veiga & Hinton 2002). Because of the aforementioned, these activities hurt the ecosystem. The livelihoods of numerous millions of people in Zimbabwe have been maintained by artisanal and small-scale mining operations, both directly and indirectly, through auxiliary services and secondary economic activities. To this extent, the socioeconomic advantages of these activities have outweighed the risks to the environment and biodiversity. However, regions where such mining is done frequently experience land degradation, air pollution, and water pollution. According to Markham and Sangermano (2018), the extraction and processing of minerals may require the usage of heavy metals such as mercury, which is harmful to flora and wildlife. Hilson and Van der Vorst's 2002 research found that artisanal miners' use of mercury for gold amalgamation causes

air pollution, contamination of surrounding water bodies, and soil contamination. Water life, humans, and animals are all at risk of exposure to methylmercury, which is formed during the amalgamation of elemental mercury.

According to Gandiwa and Gandiwa (2012), artisanal mining is generally connected with several negative consequences that jeopardize the long-term conservation of the environment, animals, and natural resources. For example, in some regions, notably those on the outskirts of towns, these operations have resulted in vegetation removal and pollution of water bodies and the air (Asner and Tupayachi 2017). In most cases, the ground is left with open pits without being recovered, resulting in soil erosion, soil fertility loss, and a general loss of aesthetic value to the area. Management of illegal artisanal gold mining in such regions has been a source of worry since it threatens biodiversity protection.

According to Funch's (2014) research on the impacts of artisanal gold mining on local livelihoods and the environment in Cameroon's forested areas, 75% of miners believe that artisanal mining has no negative impact on the environment when asked about the effects of their activity on the environment. These denials could be due to miners' lack of understanding of environmental repercussions or their fear of being implicated and prosecuted for environmental destruction. The majority of miners, however, were aware that they were operating illegally, with only a minority being aware of the harmful environmental effects of mining. Funch (2014) reported that other impacts included the diversion and sedimentation of some rivers, as well as the fact that miners mined in forest swamp areas, diverted river courses, and operated in diverted riverbeds. One of the most serious environmental consequences of artisanal mining is soil deterioration and land damage, which occur when miners leave open and unfilled holes after mining. Because no plants can grow around open mines, they become traps for animals, as well as breeding sites for mosquitos.

2.5 The severity of the environmental effects caused by artisanal and small-scale mining

Artisanal and small-scale mining can have a wide range of environmental impacts. However, the amount of these effects is determined by several criteria, including the type of mining activity, the location of the mining site, the size of the operation, and the type of ore being extracted. According to Douglas (2019), some of the common environmental impacts of ASM include water pollution caused by the release of heavy metals, acids, and other pollutants into water sources, soil contamination caused by topsoil erosion, waste rock release, and heavy metal leaching into the soil, and air pollution caused by dust and gasses emitted by mining operations. These impacts also include biodiversity loss due to habitat destruction and the introduction of invasive species and also include health impacts, such as respiratory illnesses caused by air pollution and diseases caused by contaminated water (Douglas, 2019). These impacts have significant consequences for local communities and the environment; they can create problems for the government and international organizations that will be working to address environmental issues.

Olie (2023) understands the presence of a great deal of variation in the extent and severity of environmental impacts from artisanal and small-scale mining in semi-urban communities. These impacts can include water contamination, soil erosion, and deforestation among others. Olie further opines, therefore, that it is fair to say that these activities can have significant negative effects on the environment, especially if they are not well-regulated and managed. However, some urban communities have been able to mitigate these impacts through collaborative approaches with local governments and mining companies, but many continue to face many challenges. Artisanal and small-scale mining activities have had significant social impacts on local communities including changes to structures, gender roles, and local power

dynamics. In addition, they can also have positive and negative impacts, depending on how they are managed. For example, they can provide important income for local communities, but can also lead to economic instability and conflict if not managed well.

2.6 Measures being taken to mitigate the impacts of artisanal ad small scale mining on the environment

Given the complexities of artisanal and small-scale mining challenges, all levels of government, industry, and civil society must work together to increase their contribution to sustainable development. The strategy should be tailored to the local social, cultural, and economic factors. The main sources of particles in open pit mining are blasting, excavation, handling and loading aggregate onto storage piles, and vehicle transport of mined material. Therefore, it is essential to conduct thorough controls over these activities and implement specific mitigation strategies that minimize the quantity of particulate material produced by these activities and their negative effects on the environment.

Veiga, Scurrah, and Caceres (2016) found that numerous methods can be adopted to reduce the environmental implications of artisanal and small-scale mining. The measures include requiring miners to use best practices and technologies for ore processing and waste management, such as gravity separation and mercury-free processing, encouraging the use of safer and more sustainable mining techniques, such as hand-sorting and panning, and conducting regular environmental monitoring and compliance audits to ensure miners are following environmental regulations (Veiga, Scurrah, and Caceres, 2016). Miners and other stakeholders should also receive environmental best practices training and instruction. Another option that can be undertaken is to educate and teach miners on correct waste disposal methods and the use of relevant technologies to reduce environmental effects.

It is also vital to recognize that three major areas of environmental effect must be addressed: water quality, air quality, and land use. In terms of water quality, artisanal and small-scale

mining activities or operations have the potential to pollute water sources with chemicals such as mercury and cyanide, so strategies to mitigate this impact could include the use of water treatment systems or recycling the water used in operations. According to Viega et al. (2016), emissions from mining activities can be lowered by improving ventilation systems or using cleaner fuels. Finally, land use can be enhanced by returning mined areas to their natural form or rehabilitating the land for alternative purposes such as agriculture. It is also crucial to note that the specific tactics that must be applied differ according to the location of the mining activity.

Environmental problems were discovered in a study of the interaction between hazards, control measures, health and safety in Zimbabwe's ASGM, according to Singo, Isunju, Moyo, Steckling-Muschack, Bose-O'Reilly, and Mamuse (2023). This study also supports previous studies. The investigation confirmed that alluvial ores enter waterways, possibly contributing to the Gadza River's siltation and subsequent scarcity of water. However, administrative control techniques such as raising knowledge about reforestation, rehabilitation, climate change, and planetary health would be required to mitigate In 2012, the United Nations Environmental Program (UNEP) launched a global initiative to reduce and, where possible, eliminate the use of mercury in gold processing in ASGM, among other measures, in an attempt to control the long-term environmental effects of artisanal and small-scale mining. Thus, it is also believed that the implementation of consumer certification programs and the establishment of specific standards by ASGM, which include legitimacy and responsible mercury use as the benchmark for gaining access to just international markets for gold, have helped to reduce environmental impacts. According to Singo et al. (2023), routine inspections and awareness-raising on PPE use in ASGM have occurred in Zimbabwe. ate all of these and other problems.

2.6.1 Legal Framework in Zimbabwe

Numerous studies have indicated that one of the strategies to control the environmental implications of artisanal and small-scale mining activities has been through government regulating systems. This would involve the issue of inspection permits, mining licenses, and permissions for environmental impact assessments, among other mechanisms. This would also need the government to enforce the law. Various legislative and regulatory frameworks in Zimbabwe govern and impact the management of mining resources. While some of the laws are intended to strengthen the administrative process, others are local natural resource management by-laws that apply to a specific industry, such as industrial waste disposal and environmental rehabilitation near mine sites. According to Viega et al. (2016), laws should be implemented to ensure that artisanal and small-scale mining operations comply with environmental requirements.

Ncube-Phiri, Ncube, Mucherera, and Khululi Ncube (2015) discovered a conflict of interest among the many government entities and departments responsible for maintaining control and regulation of ASM operations. The Ministry of Mines, ZINWA, the NPW Department, the Forestry Commission, and the Ministry of Forests are among the organizations or departments that are anticipated to conduct awareness campaigns. But these organs wind up with conflicting agendas, and the campaigns fall short. All gold mining operations in Zimbabwe are regulated and formalized by the Ministry of Mines through the Ministry of Small and Medium Enterprises, which exacerbates land degradation. Conversely, law enforcement, the Zimbabwe Republic Police (ZRP), the EMA, and the Forestry Commission, who resist deforestation and land degradation, find it difficult to carry out their mandates because they seem to be going against government directives. Wisner et al. (2004) found that developing sound information systems about the hazards and risks connected with small-scale mining would assist communities in developing relevant coping strategies. Furthermore, an

understanding of the ecological disasters associated with gold panning is critical for decision-making, planning, and implementation of development projects that compete for the same resources in the district, such as rural, urban, legal, and illegal mining, as well as irrigated commercial and subsistence agriculture. According to Ghose (2003), community participation promotes efforts to "advocate for cleaner production techniques to be used in the purification of gold to reduce impacts on gold panners and the environment."

In addition, lowering the height from which material discharges are made, such as washing vehicle tires, placing covers on conveyor belts or storage points, or reducing vehicle speed, are examples of different dust reduction measures that can be used in a mining environment. However, it is critical to ensure that these precautions are implemented effectively, with special consideration for the local weather. Meteorological variables, such as wind direction or speed, must also be considered because they can aid in the management of mine activities and, as a result, the optimization of mitigation measures. According to Takeda et al. (2020), anticipating meteorological occurrences will help to prevent high amounts of particulate matter as they are critical for air pollution.

A study conducted between 2014 and 2015 with a focus on the reduction of the environmental impacts of artisanal and small-scale gold mining (ASM) in Gabon through the development of a monitoring mechanism revealed that a gap analysis of the Fairmined Standard was conducted, and mining groups established and validated improvement plans. Additionally, the successful deployment of the miners' registration on pilot sites and the increasing of miners' awareness regarding the legal framework and initiation Additionally, the study found that reducing the consequences can be achieved through local sluice manufacturing and testing with miners, as well as through the creation and delivery of a database on the ASM sector that includes production, activity, social, and environmental parameters that allow for the monitoring of the activity's evolution. Additionally, the study involved an analysis of the

national concept and the design of a formalization approach that is consistent with Fairmined certification within the existing legal framework. (WWF, 2015).

Priester & Hruschka (1996) ASM frequently utilize excavation and extraction techniques that are damaging to their health and the environment, offering significant problems to governments, and making it impossible for them to change standards rapidly through regulation and enforcement. Governments should warn citizens about the threats to themselves, their children, and the environment in general. When governments work with large-scale businesses, one of the first requirements is an environmental impact assessment (EIA) and an accompanying environmental management plan. However, this is prohibitively expensive for the majority of small-scale miners, who will either try to comply by hiring low-quality environmental experts or, more likely, continue to operate illegally. In such cases, one solution would be to bring small-scale miners together to conduct a collective EIA, assuming that smallscale mining operations in an ecologically homogeneous zone will have similar environmental impacts and thus could use identical environmental management plans.

2.6.2 Mines and Minerals Act

According to the Act, all mining rights in Zimbabwe are vested in the State President as a Trustee of all natural resources in the country, but they can still be purchased by individuals, partners, businesses, and corporations, among others. The rights take the form of a permit, which grants the holder access to mine minerals within the designated region.

2.6.2 Environmental Management Act

The law was passed as a sweeping piece of legislation that superseded even the Mines and Minerals Act (Chapter 21:05). The law protects social, economic, and environmental rights while also introducing a provision for the sustainable development of all natural resources,

including minerals. Other legislation and instruments include the Traditional Leaders Act and the Mining Alluvial Gold Public Streams Regulations of 1991 (Statutory 275 of 1991).

2.7 Chapter Summary

The chapter covered the theoretical and conceptual frameworks that gave rise to the study, the particular environmental effects of small-scale and artisanal mining in Kitsiyatota, the degree to which these activities have an impact on the environment, and the tactics being used to lessen those effects. The majority of the chapter was devoted to reviewing prior research on the topic.

Research methodology will be the main topic of the upcoming chapter.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

This chapter describes the research technique, focusing on the research philosophy and design employed in the study. The chapter also discussed the study population, sampling procedures and methodology, and the sample. Furthermore, this chapter addressed data-gathering methods, with a particular emphasis on research tools. A pilot study was also briefly given, and data presentation processes and ethical considerations were discussed before concluding with a chapter summary.

3.2 Research Philosophy

A research philosophy is a set of beliefs and assumptions that drive a researcher's approach to performing research. Gill (2019) distinguishes three main research philosophies: positivism, interpretivism, and pragmatism. Unlike interpretivism, which maintains that reality is subjective and can only be comprehended qualitatively, positivism is based on the premise that reality can be objectively measured and studied by quantitative methods. However, pragmatism is a hybrid of the two, believing both qualitative and quantitative methods can be applied to comprehend reality. As a result, this study followed the pragmatic research philosophy, since the researcher attempted to incorporate both quantitative and qualitative research methodologies during the research process, resulting in mixed methods. The combination of qualitative and quantitative research methodologies would help to compensate for the deficiencies of each. According to Johnson and Onwuegbuzie (2004), pragmatic research is founded on the concept that the most appropriate procedures for answering a research issue are determined by the context and goal of the study. It is also adaptable, allowing the researcher to change their strategy as the investigation progresses.

3.3 Research Approach

The rationale for doing mixed methods research (pragmatism) is a crucial consideration. Because results from multiple methods can improve our understanding of the difficulties and concerns we face, the adoption of a mixed methods approach is critical. Furthermore, the mixed methods technique may be useful in progressing advanced research topics in the chosen sector (Molina, 2012). According to Creswell et al. (2018), the core premise of mixed methods techniques is that combining quantitative and qualitative approaches leads to a greater understanding of research challenges and complicated phenomena than using either approach alone. Triangulating one set of results with another can lead to a better understanding and increase the validity of inferences. Complementarities, development, and expansion are other key aspects of mixed methods research, as are its aim, rationale, and benefits. Mixed methods approaches are difficult since they need more work and financial resources, as well as additional time for researchers to build both quantitative and qualitative methods abilities. Thus, the mixed method technique was heavily used in this study since the researchers wanted to incorporate quantitative and qualitative methodologies while dealing with the environmental effects of artisanal and small-scale mining.

3.4 Research Design

When researching any issue, a variety of research designs can be used. According to Saunders (2009), research designs might be exploratory, experimental, descriptive, explanatory, diagnostic, or hypothesis testing. Each study design is determined by the type of research being undertaken and the methodologies used to collect data. Creswell (2018) defines a research design as a plan or approach for conducting a study. A research design, which is also based on the study's goals and research philosophy, specifies the procedures for data collecting and analysis. In a similar spirit, Bairagi and Munot (2019) acknowledge that the study design is the most important stage in guiding the research problem. The entire plan for this design

includes the study type, data-gathering tactics, experimental designs, and statistical methodologies for data samples. A research design's primary purpose is to provide a study plan that allows for the exact examination of the causal relationships between independent and dependent variables. Because it was limited to Kitsiyatota mining claims in Bindura, this study combined a case study technique with an exploratory research design.

3.4 Population and Sampling

3.4.1 Population

A research population is a specific group of persons or subjects who share the qualities investigated in the study, and it may also be thought of as a collection of items, subjects, or members who meet certain criteria in a given area. The research population included all seventy artisanal and small-scale miners, municipal officials, EMA, Mines and Mining Development Ministry, ZRP, and residents of the NRZ compounds. Rubin and Babbie (2007) define population as an aggregation of components from which we can draw a sample. Furthermore, a research population is typically defined as the larger group of people to whom the researcher aims to generalize the study's findings. According to Kahn and Best in UDOBA (2014), a population is a collection of people who share certain qualities that the researcher is interested in. Similarly, Salkind (2012) defines population as the entirety of all units that are eligible to participate in a study.

3.4.2 Sampling

Sampling is the process of identifying and selecting study subjects. In research, two types of sampling procedures are often used: probability and non-probability sampling. The most popular sampling procedures include random sampling, stratified sampling, cluster sampling, convenience sampling, judgmental or purposive sampling, and snowballing. However, this study included both probability and non-probability selecting approaches, resulting in the employment of simple random and judgmental selection strategies to pick

research participants. Participants were chosen based on their involvement and participation in mining and associated industries.

3.4.3 Sample size

A sample size is the number of study participants required for statistically significant results (Berndt & Petzer, 2011). According to Malhotra (2010), the sample size is determined by several factors, including the number of configuration-related items and the nature of the inquiry. A total of 70 people were chosen to participate in the study. The participants included 44 artisanal and small-scale miners, 4 officers from the ZRP Minerals Flora and Fauna Unit (CID), 3 EMA, 5 Bindura municipal officials, 5 officials from the Ministry of Mines and Mining Development, 4 residents from NRZ compounds, 3 from the Office of the President and Cabinet (Provincial Affairs Minister's Office), and 2 lawyers.

3.5 Data Collection

There are various data-gathering tools, often known as research instruments. The questionnaire, interview guide, focus group talks, observation method, and document analysis are some of the most commonly used instruments. The study approach used influences the choice of a certain data collection technology. Thus, data can be acquired qualitatively or quantitatively. This study collected data from respondents using a questionnaire, an interview, and observation.

3.5.1 The Questionnaire

The questionnaire is a data collection tool composed of a series of questions posed to participants (Denscombe, 2016). Questionnaires can be paper-based or digital, and they are commonly used in survey research. Questionnaires are an inexpensive and efficient tool to collect data from a large sample, and in this case, the questionnaire was also utilized to pilot the research. They also allow for standardized data gathering, which makes it easier to compare outcomes between groups. However, questionnaires have limitations in terms of their ability to

collect complex or sensitive information, and they might be biased if the questions are not carefully prepared.

3.5.2 The Interview

An interview guide is a tool for structuring an interview and ensuring that the same set of questions are asked to all participants. Bradley, Daly, Newman, Solomons, and Turner (2018) define an interview as a data-gathering tool in which participants are asked questions in person or over the phone. During the interview, participants are asked questions either in person or over the phone. The interview can include both open-ended and closed-ended questions and can be conducted in both organized and semi-structured formats. Interview guides are frequently used in qualitative research because they allow the interviewee to have in-depth discussions on the issue (Bogdan and Biklen, 2007). In this study, interviews were performed with officials from ZRP, Mines Ministry, EMA, and Bindura municipality.

3.5.3 Observation method

The observation method is a qualitative research strategy that involves seeing individuals in their natural environment and gathering data on their behaviors and interactions (Babe, 2020). This can be accomplished through direct observation, in which the researcher physically observes the participants, or participation observation, in which the researcher actively participates in the participants' activities. The primary benefit of employing the observation approach is that it helps researchers acquire a more in-depth insight into the participants' behavior and experiences. However, ensuring that the observations are accurate and unbiased can take time and be challenging. Furthermore, Patton (2019) contends that the observation approach is a great tool for data collecting, but it can also pose certain obstacles. For example, it might be difficult to acquire objective data through observation since the researcher's prejudices and opinions can influence the procedure. Patton also claims that employing this strategy makes controlling for confounding variables difficult, as well as time-

consuming and labor-intensive. However, Patton (2019) asserts that the observation method remains a powerful tool for gathering rich and thorough data.

3.6 Validity and reliability of research instruments

The researcher carried out a pilot study to ensure the validity and reliability of the instruments used.

3.6.1 Reliability

Reliability, according to Patsanza (2014), has to do with the research instrument's accuracy when used frequently or on the same participants. The outcomes should be the same if the device is trustworthy. As a result, an instrument's measure of consistency is its reliability.

3.6.2 Validity

The validity of a research instrument and the veracity of its findings are determined by its ability to measure what it was designed to assess. Put differently, it refers to whether the research tool enables the researcher to identify the key points in the study subject (Tuckman, 2013).

3.7 Pilot Study

According to Ferrell (2009), a pilot study is a study undertaken to pre-test a research instrument. Thus, to test for the acceptability and suitability of such instruments a pilot study was undertaken at Mukaradzi mining claims in Mt Darwin. This helped in determining the degree of the subjects` interpretation of questionnaires and other research instruments that were used while corrections were made where possible.

3.8 Ethical considerations

Ethics are moral principles that guide human behavior. These morals deal with what is right or wrong, nice or terrible. These are the moral requirements and principles that researchers

should always follow when doing and publishing their study. Moral decisions influence norms, behavior, and ethical decisions (Greener, 2008). Furthermore, ethics can be defined as the area of philosophy concerned with values relating to human behavior, such as the rightness or wrongness of specific behaviors, as well as the goodness or badness of the motives and ends of such actions (Summer, 2007). Ethics promotes the aims of the study, such as advancing knowledge, while also promoting the values essential for collaborative work, such as mutual respect and fairness, relying on collaboration. According to Creswell (2014), there are specific research standards of ethical behavior that should be followed in every study, which include the following:

3.8.1 Informed consent

To clarify, the researcher educates the respondents and participants verbally about the study's aim, objectives, and nature.

3.8.2 Harm and Risk

The researcher guarantees both respondents and participants that there was no risk or harm to participating in the study.

3.8.3 Honesty and Trust

The researcher makes every effort to be truthful and honest throughout the data collection process and analysis and asks the respondents and participants if they would want to receive the results.

3.8.4 Privacy, confidentiality, and anonymity

Throughout the data collection process, the researcher guarantees that respondents and participants are kept confidential and anonymous and that no names are utilized for purposes other than those intended by the study.

3.8.5Voluntary participation

The researcher informed the responders and participants that the study was solely for academic purposes and that their participation was entirely voluntary since no one was forced to participate.

Finally, the researcher ensured that issues of plagiarism in the study were correctly addressed. Before committing to the research process, participants were informed about the study's goal. Authorities requested and granted permission to conduct the study at the claims. In terms of preventing physical or psychological injury, assurances were given that no such thing would happen to the study's subjects, as it was believed to compromise the study's outcome. The type of questions asked may have caused psychological distress, however, based on the focus group talks, there was no such effect.

3.9 Data Presentation, Interpretation, and Analysis

Data analysis is the process of examining data to draw conclusions and make decisions (Smith, 2019). Data analysis comprises transforming and analyzing data using statistical methods. Furthermore, data analysis can be used to establish a dataset, analyze data links, and predict future results. Winter (2017) discusses many approaches to data analysis, such as descriptive statistics, inferential statistics, and machine learning statistics. The data will be evaluated with SPSS, a statistical software application that can perform a variety of statistical analyses, including ANOVA.

3.10 Chapter Summary

This chapter focused on the study's methodology, including its design and research philosophy. Among other things, the researcher used an exploratory study design, a mixed

research method, and a pragmatic mindset. This chapter covers the research population, sample size, sampling technique, data gathering equipment, and the process. Several initiatives were taken to increase the validity and reliability of the study techniques and conclusions. Concerns concerning ethics that may have impacted the study were also addressed. The display, analysis, and interpretation of data will be the primary topics of the following chapter.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The primary focus of this chapter was to provide and analyze research on the environmental implications of artisanal and small-scale mining in the Kitsiyatota mining claims in Bindura Urban. By investigating these findings, it is possible to identify potential development areas and propose strategies to prevent further harm to the ecosystem and other species. For simplicity of use and comprehension, data that could not be quantified were provided verbatim.

Other statistics were given in the form of tables, pie charts, and graphs.

4.2 Demographic data presentation

To increase confidence in the research responses and conclusions, the various demographic and work-related characteristics of the study participants were profiled. These included gender, age, academic qualifications, and job experience, which was determined by the number of years worked on the mining claims.

4.2.1 Gender profiles

The study also looked into the gender profiles of research participants in the small-scale and artisanal gold mining sector. Table 4.1 shows the distribution of participants according to their gender profiles.

Table 4.1 Gender profiles (n=32)

Gender/sex	Frequency	Percentage
Male	18	56.25%

Female	14	43.75%

(Source: Primary Data)

Table 4.1 sought to establish the gender profiles of all the people who participated in the study. Research findings show that the majority, (18) 56.25% of respondents were male participants while their female counterparts constituted (14) 43.75% of them. This helped to ascertain the number of small-scale miners involved according to their specific gender. Knowing the gender of participants can help researchers identify issues that one gender might do more than the other at the workplace, and this also helped researchers to develop interventions that would help address the specific needs of men and women which could improve their effectiveness in doing their work.

4.2.2 Age profiles

The study also looked into the experiences of participants in the small-scale and artisanal gold mining sector. Table 4.2 shows the distribution of participants according to their ages.

Table 4.2 Age profiles for respondents (n=32)

Age ranges	**Frequency**	**Percentage**
16-20 years	5	15.63%
21-35 years	15	46.88%
36-40 years	9	28.13%
41 years +	3	9.38%

(Source: Primary Data)

Table 4.2 sought to determine the age profiles of each of those people who participated in the research process. Research findings indicate that the majority, 46.88% of all respondents

revealed that they were between 21 and 35 years of age while 28.13% of them were between 36 and 40 years. However, findings also show that 15.63% of the research participants were between 16 and 20 years old while the least 9.38% of them were 41 years and above. Knowing the ages of the respondents helped to understand how they think and respond to interventions, and also to understand how behaviors change over the lifespan and helped the researcher to address the unique needs and challenges of the different age groups.

4.2.3 Highest educational level

The study also profiled the highest educational qualifications for each of the people who participated in the research. Figure 4.1 shows the qualification profiles of respondents.

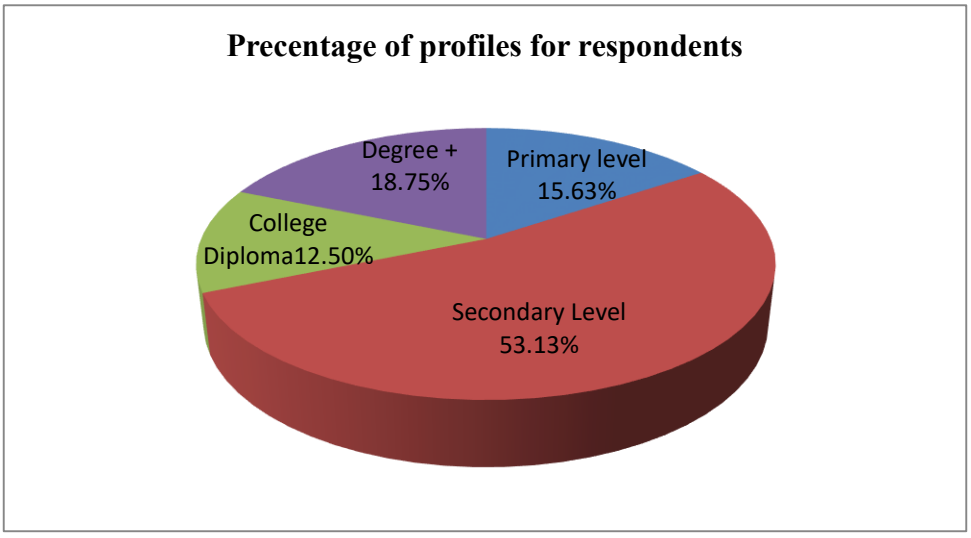

Figure 4.1 Educational profiles for respondents. N=32 (Source: Primary Data)

Figure 4.1 sought to establish the educational profiles of research participants. Findings from the study show that the majority, 53.13% of research participants attained secondary education whilst only 18.75% had degrees to their credit. Findings also show that 15.63% only attended primary education and could not proceed to the secondary level due to economic hardships while the least 12.5% had college diplomas. This also helped the researcher to deal

with each of the respondents based on his or her educational level as this would also determine their level of understanding of issues with mining from different perspectives.

4.2.4 Period of Mining at Kitsiyatota

The study also profiled the period of mining at Kitsiyatota mining claims for each of the research participants in the study. Figure 4.2 shows the different age profiles of respondents.

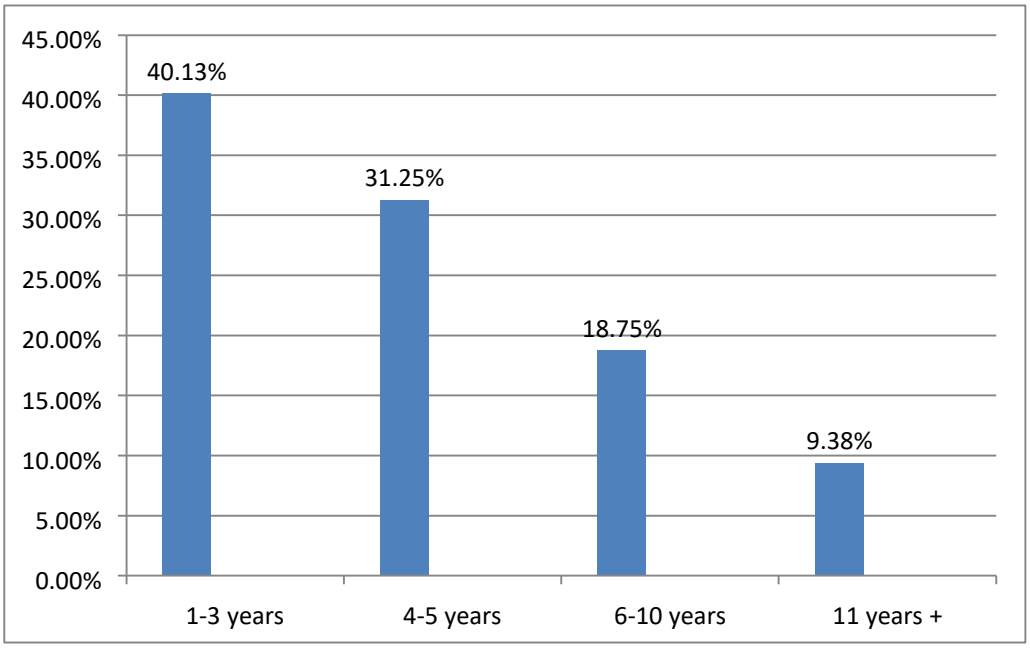

Figure 4.2 Length or period of mining at Kitsiyatota. N=43. (Source: Primary Data)

Figure 4.2 sought to establish how long each of the respondents had been mining at Kitisyatota. Findings suggest that the majority, 40.13% of respondents had been mining at Kitisyatita for a period between 1 and 3 years whilst 31.25% of them have been there for a period between 4 and 5 years. The study also found that 18.75% of research participants have been at Kitsiyatota for a period between 6 and 10 years whilst the least 9.38% have been there for more than 10 years. This helped to get much of their experiences.

4.3 Effects of Artisanal and small-scale Mining on the Environment at Kitsiyatota

4.3.1 Challenges faced by artisanal and small-scale miners in trying to protect the environment

The study also investigated the challenges being faced by artisanal and small-scale miners as they try to prevent further damage to the environment. Figure 4.3 illustrates the challenges.

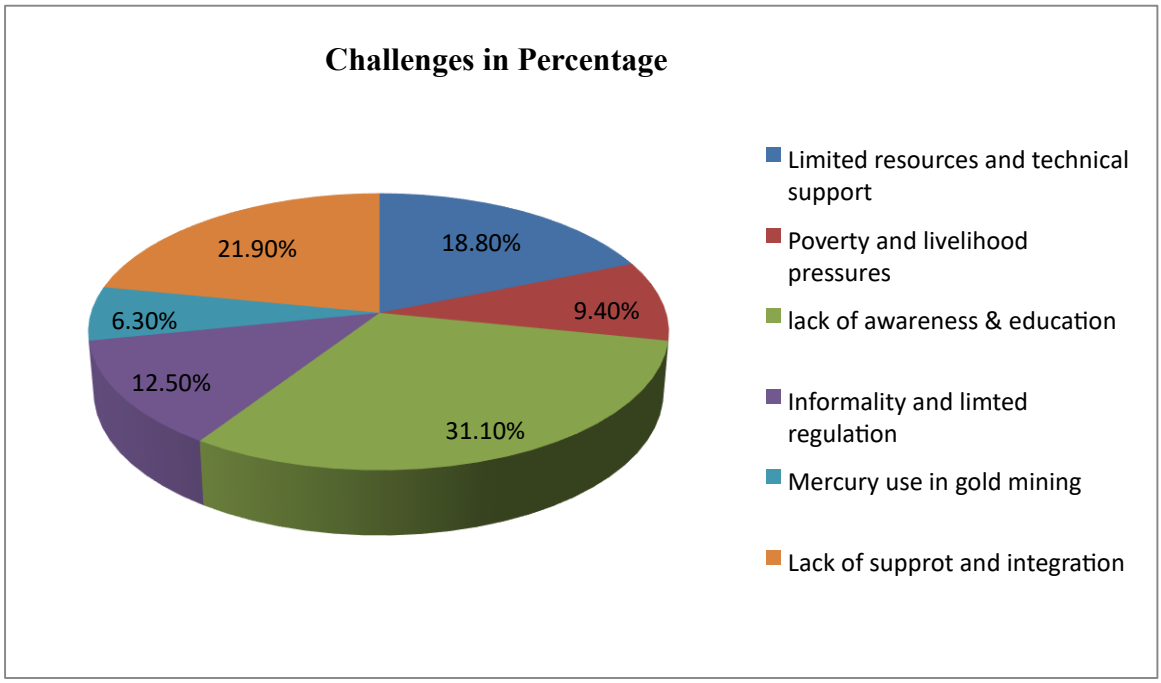

Figure 4.3 Challenges faced in mitigating further damage to the environment (n=32)

(Source: Primary Data)

Figure 4.3 sought to determine the challenges faced by artisanal and small-scale miners as they try to mitigate further damage to the environment. Research findings show that the majority, 31.1% of respondents attributed the challenges to lack of awareness and education

among the miners while 21.9% of them cited lack of support and integration as challenges facing them, although 18.8% of them also said limited resources and technical support were contributing to these challenges as they try to mitigate further damage to the environment. The availability of such resources and support would help them implement environmentally sustainable practices. Research findings further show that 12.5% of research participants attribute these challenges to the informality of the sector and limited regulation while 9.4% of them revealed that much of these challenges were caused by poverty and livelihood pressures among the miners. The study further found that the least 6.3% of respondents attributed their challenges to the use of mercury in gold mining.

4.3.2 Environmental effects faced by artisanal and small-scale minors (n=32)

The study also interrogated environmental-related challenges faced by artisanal and small-scale miners at Kitisyatota. As a way to instigate an inquiry of evidence towards the availability of challenges related to the environment that are being or have been faced by small-scale and artisanal minors at the mining claims.

Table 4.3 Environmental challenges faced by minors (n=32)

Environmental challenges faced by minors	Frequency	Percentage
Land degradation	12	37.5%
Loss of biodiversity & deforestation	6	18.76%
Pollution (Air, noise, and water)	10	31.25%
Soil erosion and contamination	3	9.38%

(Source: Primary Data)

Table 4.3 sought to identify challenges that are linked to the environmental effects of artisanal and small-scale mining at Kitsiyatota in Bindura. Research findings show that the

majority, 37.5% of research participants revealed that such activities have resulted in massive land degradation in mining areas whilst 31.25% of them spoke of air, water, and noise pollution as major challenges faced by the minors. Findings also show that 15.63% of respondents revealed that loss of biodiversity and deforestation have been some of the environmental challenges that are caused but artisanal and small-scale mining activities at Kitsiyatota whilst the other 9.38% indicated that soil erosion and soil contamination were some of the challenges resulting from artisanal and small-scale mining. However, the results show that respondents were eager to participate in the process. The above findings concur with Chakuya, Munkuli, Mutema, and Gandiwa (2023) who indicated that illegal artisanal gold mining threatens biodiversity conservation within protected areas among other issues.

Miner 1 had to say this:

"When we dig and move soil to extract gold the land becomes very loose during the rainy season and the rain washes away the soil which causes erosion and that also affects the farmland nearby and this has also habitants for animals because we don't see as many birds or other wildlife around"

4.4 The extent and severity of the effects of artisanal mining on the environment

One of the major objectives of the study was to look into the extent and severity of the effects of artisanal or small-scale mining on the environment. The magnitude of effects of the mining activities was categorized into activity effects on the phenomenon.

4.4.1 SM activities endangering the environment

The study also solicited views from respondents on whether they agreed with the view that mining activities were a danger to the environment or not. Table 4.4 illustrates the findings.

Table 4.4 Mining activities endanger the environment (n=32)

Reaction/Responses	Frequency	Percentage
Strongly Agree	12	37.5%
Agree	8	25%
Not certain	2	6.25%
Disagree	4	12.5%
Strongly Disagree	6	18.75%

Source: Primary Data

Table 4.4 sought comments on the effect of mining activities on the environment. The study wanted to determine the levels at which these activities endangered the environment. Research findings established that the majority, 37.5% of the respondents strongly agreed with the view that mining activities endanger the environment while 25% of them were in agreement with the view. The findings further indicated that 18.75% of research participants strongly disagreed with the view that mining activities endangered the environment while 12.5% of them were in disagreement with the perception. However, 6.25% of research participants could not shed light on their thoughts rather findings show that they were not certain and therefore, reserved their comments.

Table 4.5 Comments on whether or not will cease operations if asked to (n=32)

Comments	Frequency	Percentage
Yes	11	34.38%
No	19	59.38%

Reserved answer	2	6.25%

Source: Primary Data

Table 4.5 sought to determine whether respondents could cease mining activities in the event they were asked or ordered to do so by the authorities. Findings suggest that the majority, 59.38% of respondents, over half of them revealed that they were not prepared to cease operations as this was their source of livelihood while 34.38% of them said would comply if they were given something better. However, the least, 6.25% of them were skeptical and were not sure of what they would do in the event of such an order being given. Considering the circumstances in the economy it is difficult for the artisanal and small-scale miners to cease their operations as this is their source of livelihood.

4.5 Challenges faced by artisanal and small-scale gold miners

4.51 Challenges faced by artisanal and small-scale miners at Kitsiyatota

It was also important to investigate challenges being faced by artisanal and small-scale miners in their day-to-day mining activities.

Table 4.6 Challenges faced by artisanal and small-scale miners (n=32)

Challenges	**Frequency**	**Percentage**
Underground flooding	1	3.13%
Lack of knowledge	3	9.38%
Demand for bribes by law by the police	4	12.5%
Lack of proper risk assessment	1	3.13%
Inadequate/lack of proper mining equipment	11	34.38%

Noise	2	6.25%
Chemicals & related diseases	3	9.38%
High rate of prostitution	1	3.13%
Loss of life due to mine collapses	9	28.13%
Lack of funds	6	18.75%
Lack of proper occupational health & safety plans	6	18.75%
Occupational Injuries	7	21.88%
Lack of water supply	2	6.25%
Lack of legal protection & unfair competition	3	9.38%
Violence	3	9.38%

(Source: Primary Data)

Table 4.6 sought to find the challenges being faced by artisanal and small-scale miners. Findings from the study indicate that the majority, 11(34.38%) of research participants cited inadequate or lack of proper mining equipment as one of the challenges faced by artisanal and small-scale miners while 9 (28.13%) of them revealed that several miners have lost their lives due to mine collapse. Findings further show that 7 (21.88%) research participants revealed that many of the artisanal and small-scale miners have had occupational injuries while 6 (18.75%) of them cited a lack of proper occupational health & safety plans with another 6 (18.75%) citing lack funds or capital injection as some of the challenges faced by AS Miners at Kitsiyatota. The study further found that the least 1 (3.13%) of respondents revealed that underground mine flooding lack of proper risk assessment and increasing rate of prostitution are serious challenges facing artisanal and small-scale miners respectively. However, participants cited other serious challenges faced by these miners. The challenges include knowledge on the part of the miners and demand for bribes by law enforcement officers. Some of them cited chemical and related

diseases, noise, lack of legal protection and unfair competition, violence, and lack of water supply among others.

Second miner had to say this:

"*Mining can also cause environmental health problems when we are exposed to harmful chemicals or work in unsafe conditions, it can lead to respiratory issues and other health problems in the long term*"

Table 4.7 Effects of artisanal mining on the ecosystem

The effects	**Frequency**	**Percentage**
Environmental, land degradation & soil erosion	12	37.5%
Deforestation and Climate Change	8	25%
Land, air and water pollution	6	18.75%
Loss of human life and biodiversity	4	12.5%
Burning of bushes, destruction of river systems	2	6.25%

Source: Primary Data

Table 4.7 sought to establish the effects of artisanal mining on the ecosystem. Research findings show that the majority, 37.5% revealed that artisanal has resulted in environmental, land degradation and soil erosion while 25% of them claimed that artisanal mining has contributed to deforestation and climate change respectively. 18.75% of the respondents revealed that artisanal mining has also contributed to land, air, and water pollution whilst 12.5% of them revealed that these activities have caused loss of human life and biodiversity. However, the least 6.25% of respondents indicate that artisanal mining has caused the burning of bushes (veld fires) and, the destruction of river systems.

4.6 Measures for reducing the effects of artisanal mining on the environment.

4.6.1 Strategies for Improving Mining Activities at Kitsiyatota

The study investigated whether any strategies could be suggested to improve mining activities at Kitsiyatota mining claims in Bindura. Table 4.8 presents the results of the investigation of the study carried out at Kitsiyatota.

Table 4.8 Strategies to Improve Mining Activities (n=32)

Strategies for Improving Mining Activities	Frequency	Percentage
Need for capital injection (loans) and drilling boreholes	4	12.5%
Legal protection, favourable policies, and proper regulatory framework in place	10	31.25%
Support from established mines & knowledge sharing	1	3.1%
Training on proper mining methods and addressing unfair competition	6	18.75%
Improved working conditions as well as safety and occupational health	3	9.4%
Mechanization in the mining sector and introduction of new mining technologies	8	25%

Source: Primary Data

Figure 4.8 sought to determine strategies that could be suggested to improve artisanal and small-scale mining activities in Zimbabwe. Research findings suggest that the majority,

31.35% of research participants called for legal protection, favorable policies, and proper regulatory framework to be in place while 25% of them advocated mechanization in the mining sector and the introduction of new mining technologies as ways to improve mining activities artisanal and small-scale miners in Zimbabwe. Research findings further show that 18.75% of respondents called for training on proper mining methods and for authorities and regulators to address unfair competition among miners in the sector. 12.5% of research participants felt there is a need for access to loans for capital injection and also felt the need to drill boreholes in areas where there is no adequate water supply for their activities while 9.4% called for improved working conditions as well as safety and occupational health programs to be implemented in the sector. However, the least about 3.1% of respondents revealed the need for support from established mines and knowledge sharing among miners.

Third miner had to say this:

" *After finishing mining a site, we should make an effort to restore the land. This could include replanting trees and covering up dug-up areas to prevent erosion. Some organizations offer support to help us rehabilitate the land*"

4.6.2 Strategies to reduce the effects of artisanal mining on the environment

The study also looked into tactics and potential solutions for reducing the environmental impact of artisanal mining operations. Knowledge of the strategies would aid in protecting the environment from additional detrimental consequences. Artisanal mining can hurt the environment if not managed properly.

Table 4.9 Strategies to reduce the effects of mining on the environment (n=32)

Strategies	**Frequency**	**Percentage**
Formalizing and regulating artisanal mining activities	8	25%

Providing education and training	7	22%
Providing technical support and guidance	10	31%
Strengthening monitoring and enforcement	1	3%
Supporting alternative livelihoods	2	6%
Fostering collaboration and partnerships	4	13%

(Source: Primary Data)

Table 4.9 sought to determine strategies that could be implemented to reduce the effects of artisanal and small-scale mining on the environment. Findings from the study suggest that the majority, 31% revealed the need for providing technical support and guidance to artisanal and small-scale to promote environmentally friendly practices while 25% of them called for the formalization and regulation of artisanal mining activities by establishing clear legal frameworks and regulations for ASM activities in the country and this would help bring the sector under governance, enable better monitoring, control and enforcement of environmental standards. The study further found that 22% of research participants called for the need for education and training programs for artisanal and small-scale miners to capacitate and enhance miners` knowledge and understanding of sustainable mining practices, environmental conservation, and health and safety measures while 13% of them advocated for fostering collaboration and partnerships between government, NGOs, the local community and the private sector to address environmental challenges posed by ASM. However, findings show that the least, 6% suggested the need to support alternative livelihood options for those engaged in ASM could help reduce the dependency on mining activities thereby alleviating environmental pressures while 3% said there was a need to strengthen monitoring and enforcement of laws and regulations by authorities to ensure no further damage is made to the environment.

4.6 Chapter Summary

The study attempted to look into the environmental impact of artisanal and small-scale mining at the Kitisiyatota mining claims in Bindura. This chapter presented, interpreted, and analyzed data gathered using qualitative and quantitative data collection methods. The following chapter will focus on a summary of the findings, conclusions, and potential recommendations.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND AREAS FOR FURTHER RESEARCH

5.1 Introduction

The study attempted to look into the environmental impact of artisanal and small-scale mining at the Kitisiyatota mining claims in Bindura. This chapter presented, interpreted, and analyzed data gathered using qualitative and quantitative data collection methods. The following chapter will focus on a summary of the findings, conclusions, and potential recommendations.

5.2 Summary of findings

5.2.1 Environmental Effects of Artisanal Mining and Small-Scale Mining at Kitsiyatota

The study also investigated the challenges being faced by artisanal and small-scale miners as they try to prevent further damage to the environment. In that effort, research findings showed that most of the challenges were attributed to a lack of awareness and education among the miners while lack of support and integration were also cited among other challenges. The study further found that limited resources and technical support were also contributing to these challenges as they tried to mitigate further damage to the environment. The study noted that the availability of such resources and support would help them implement environmentally sustainable practices. In addition, findings also attributed some of these challenges to the informality of the mining sector and limited regulation while poverty and livelihood pressures among the miners were also cited as some of the challenges although the use of mercury in gold mining was also cited.

The study also interrogated environmental-related challenges faced by artisanal and small-scale miners at Kitisyatota. As a way to instigate an inquiry of evidence towards the availability of challenges related to the environmental challenges facing small-scale and artisanal minors at the mining claims research findings concluded that such activities have resulted in massive land degradation in the mining area with air, water, and noise pollution being cited as some of the major challenges. The report also identified biodiversity loss and deforestation as environmental issues caused by artisanal and small-scale mining activities in Kitsiyatota. Furthermore, the study discovered that some of the issues associated with mining activities include soil erosion and contamination. The findings agree with Chakuya et al. (2023), who said that illegal artisanal gold mining endangers biodiversity conservation within protected areas.

5.2.2 The extent and severity of the effects of artisanal mining on the environment One of the primary goals was to investigate the breadth and severity of artisanal or small-scale mining's environmental effects, which would be classified as activity effects on phenomena. In attempting to assess the levels at which these activities damage the environment, research findings revealed that mining operations endanger the environment, yet the findings also offered a different perspective, as some participants strongly disagreed. In other words, it remained hypothetical. The survey also discovered that artisanal and small-scale miners are not willing to stop mining activities if required to do so by authorities. People thought that the study could not be stopped because it was their only source of income given the current status of the economy. These findings reflect is serious issue that needs urgent attention as this would have a damming effect on the environment.

5.2.3 The Challenges faced by Artisanal and small-scale Gold miners

The study looked into the difficulties faced by artisanal and small-scale gold miners. According to the research findings, the issues experienced by artisanal and small-scale gold miners are due to a lack of knowledge and education among miners, a lack of support and integration, and limited resources and technical expertise. The study discovered that having such resources and support would help miners embrace ecologically sustainable practices. A significant number of research participants attribute these issues to the sector's informality and lack of regulation, as well as poverty and livelihood pressures among miners, while the use of mercury in gold mining was also identified as a major challenge in the sector.

Furthermore, the study investigated the environmental challenges faced by artisanal and smallscale miners in Kitisyatota, and the research findings show that mining activities have resulted in massive land degradation in mining areas, as well as massive air, water, and noise pollution, while biodiversity loss and deforestation have been cited as some of the environmental challenges caused by artisanal and small-scale mining activities in Kitsiyatota. The survey also discovered that some of the issues associated with artisanal and small-scale mining were soil erosion and pollution. The findings above confirmed those of Chakuya et al. (2023), who found that unlawful artisanal and small-scale gold mining has always hampered biodiversity conservation within protected areas. The study highlighted the negative effects of artisanal and small-scale gold mining on the environment.

5.4 Recommendations

According to a study on the environmental impact of artisanal and small-scale mining in Zimbabwe, the government should develop and strengthen regulations to protect the environment, social responsibility, and employee safety.

- Authorities should establish a robust system of environmental impact assessments and permitting processes for all gold mining operations.
- There is also a need to empower and equip regulatory agencies to effectively monitor, inspect, and enforce compliance with environmental regulations.
- The study further recommends the promotion of cleaner and more efficient mining practices.
- Should invest in environmental rehabilitation and restoration by establishing a fund or program to finance the rehabilitation of degraded lands, the remediation of contaminated water bodies, and the restoration of ecosystems affected by artisanal and small-scale mining.
- Develop guidelines and provide technical assistance to miners on effective land reclamation and habitat restoration methods.
- Provide training and incentives to encourage artisanal and small-scale miners to adopt more environmentally friendly extraction and processing techniques, such as the use of mercury-free gold extraction methods.
- Facilitate access for miners to appropriate technologies and equipment that can reduce the environmental footprint of their operations.
- Promote alternative livelihoods and sustainable development.
- The study also found that respondents need training on proper mining methods and that authorities and regulators address unfair competition among the miners in the sector.

AREAS FOR FURTHER RESEARCH

The effects of artisanal and small-scale mining (ASM) on the environment, particularly in areas like Kitsiyatota, present numerous challenges, ranging from soil erosion and water contamination to deforestation and biodiversity loss. Further research could focus on the impact of chemicals, such as mercury and cyanide, on local water bodies, assessing the long-term effects on drinking water quality and health in surrounding communities. Another key area is the deforestation and habitat loss caused by mining activities, with studies mapping land-use changes and the regeneration capacity of local ecosystems. Additionally, research on soil erosion and land degradation could explore how mining practices contribute to the loss of fertile land and affect agricultural productivity. The social and economic effects on local communities, especially the balance between the economic benefits of mining and the environmental costs, also warrant deeper investigation. Exploring the role of women in ASM and their influence on promoting sustainable practices is another important research area. Furthermore, studying the effectiveness of environmental regulations, post-mining land rehabilitation techniques, and sustainable mining technologies could provide valuable solutions for mitigating environmental damage. Research into the cumulative effects of mining on local climates and agricultural productivity, along with improving occupational health and safety standards for miners, would also contribute to developing a more sustainable approach to ASM in Kitsiyatota.

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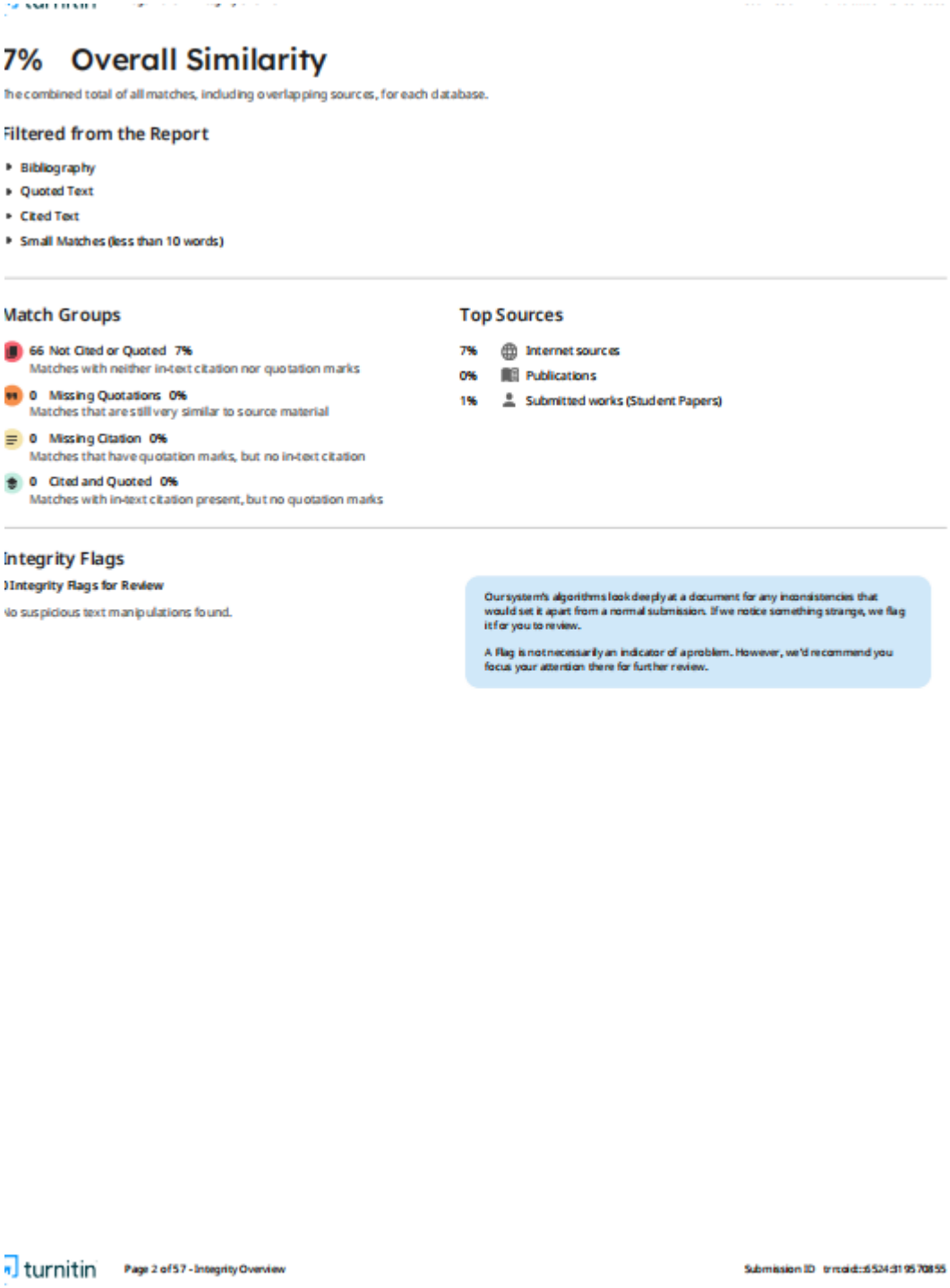
APPENDIX

INTERVIEW GUIDE

1. How do your mining activities impact local water resources, and have you ever observed any changes in water quality or availability since starting your work?
2. What methods do you use for waste disposal and how do you manage toxic substances?
3. Have you noticed any changes in local vegetation or wildlife around your mining site and what steps do you take to minimize deforastation?
4. Do you use any techniques or practices that aim to reduce environmental degradation?
5. How has the community around the mining site been affected by changes in the local ecosystem and what do you think can be done to improve the environment impact of mining in this area?



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