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ASSESSING THE IMPACTS OF ARTISANAL MINING ON ENVIRONMENT AND LIVELIHOODS IN BINDURA DISTRICT, ZIMBABWE

BY

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APPROVAL FORM

Whereby the undersigned attest to having supervised the research work titled *"Assessing the Impact of Artisanal Mining on Environment and Livelihoods in Bindura District, Zimbabwe"*, conducted by **Bestow Mambwerere (B221514B)** for partial fulfillment of requirements for

Bachelor of Arts Honours Degree in Development Studies at Bindura University of Science Education (BUSE).

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DECLARATION

I, **Bestow Mambwerere (B221514B)**, hereby declare that this dissertation titled *"Assessing the Impacts of Artisanal Mining on Environment and Livelihoods in Bindura District, Zimbabwe"* is my original work. It has been submitted in partial fulfillment of the requirements for the Bachelor

of Arts Honours Degree in Development Studies at Bindura University of Science Education. The research was conducted under the supervision of **Mr Z. Zaranyika**. To the best of my knowledge, this work has not been previously submitted for any degree or qualification at this or any other university. All sources of information used in this study have been duly acknowledged through appropriate citations and references.

BESTOW MAMBWERERE

BM…….

DEDICATION

To the artisanal miners of Bindura district who venture into the pits armed only with picks and spades, putting their health at risk from mercury poisoning and collapsed mine shafts all for a few

ounces of gold. To the boys who had to abandon their schooling to work on the banks of the river, and the women mining ore while caring for their families. And to the landscape that has been degraded, the silting up of rivers, and the forests that have fallen silent. Therefore, here is an attempt to document your struggles and your tenacity.

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ABSTRACT

This study investigated the effects of artisanal mining on the environment and livelihoods in Bindura District in Zimbabwe. Based on the theoretical framework of Tragedy of the Commons as posited by Garrett Hardin, a qualitative case study design was applied in the research. Data were obtained using 30 semi-structured interviews, four focus group discussions (n=50), non-participant observations and analysis of documents from artisanal miners, members of the community, government officials and environmental specialists. It was found out that artisanal mining is manual and minimally mechanized and it takes place within the hot spots including the banks of the Mazowe River and abandoned mine dumps. The use of mercury amalgamation for gold mining is still prevalent due to its affordable cost and lack of skills. In terms of environmental degradation, there are deforestation, land degradation, water pollution, silting of rivers and health impacts linked to mercury use. On the socio-economic dimension, artisanal mining is a source of livelihood and income for those without formal jobs although substance abuse, dropping out from school and disputes between families and among groups about access to pits and water sources occur. Unregulated free access to mineral commons results in environmental destruction and social chaos according to the research findings. The study therefore suggests streamlining registration processes, provision of training grants, encouraging livelihood diversification, and creating district-level governance forums.

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LIST OF ACRONYMS

Acronym	Full Form
ASM	Artisanal and Small-Scale Mining
AGM	Artisanal Gold Mining
ASGM	Artisanal and Small-Scale Gold Mining
BUSE	Bindura University of Science Education
CASM	Communities and Small-Scale Mining
EMA	Environmental Management Agency (Zimbabwe)
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
ILO	International Labour Organization
LSM	Large-Scale Mining
NGO	Non-Governmental Organization
NVivo	Qualitative data analysis software
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
ZINWA	Zimbabwe National Water Authority
ZIMSTAT	Zimbabwe National Statistics Agency

CHAPTER ONE

INTRODUCTION

1.1 Background of study

Artisanal mining involves small-scale and labour-intensive mining operations that utilise basic technologies. It is an essential activity in many developing countries, including Zimbabwe. In Bindura District, located in the province of Mashonaland Central Zimbabwe, it has been a key economic activity for local people. The activity has had a number of implications in relation to the environment and socio-economic factors which requires close investigation.

The environmental effects of artisanal mining in Bindura District have a wide range of implications for the District's environment and the wellbeing of its inhabitants. Some of the major environmental issues include deforestation, land degradation and water pollution. According to Mkodzongi (2020), another significant impact associated with artisanal mining relates to the use of mercury in gold processing. Mercury is used by miners to recover precious metals like gold. Therefore, the usage of the metal can result in more serious environmental degradation and health hazards.

In the Mines Minerals Bill (2025), the Zimbabwe government is stated to have put up different measures for the proper regulation of artisanal mining operations through laws such as the Mines and Minerals Act and the Environmental Management Act. There have been arguments on whether these measures have had an effect in ensuring that these issues are solved by the policy makers. In this light, this research will endeavour to analyse the impacts that artisanal mining operations have on the environment and livelihoods within Bindura District.

Mining through the use of small scale methods in Bindura district leads to deforestation where trees are cut down in order to access the mineral deposits and provide room for carrying out mining processes as well as supplying timber for energy purposes and other mining processes. Trees that are cut are not usually planted hence reducing tree cover which results in the loss of biodiversity in the area. As explained by Mkodzongi (2020), the process of small-scale mining in Bindura is another factor that leads to deforestation which in turn leads to land degradation in Zimbabwe mining areas.

The negative impacts that artisanal mining practices have in Bindura District include land degradation due to excavation, deforestation, and dumping of tailings and waste rock into the environment. Land is degraded due to soil erosion and loss of soil fertility and changes in the landscape. The use of chemicals and mercury result in contamination of the soil. In the study conducted by Chari (2020), it was established that unregulated artisanal mining practices cause further land degradation resulting in low levels of land productivity in Bindura.

Another impact of artisanal mining includes environmental pollution due to the release of mercury and other chemicals in the CPI process. Mercury vapour is emitted during the CPI process, which is dangerous for both miners and the people living around the area. Tailings and waste rocks are dumped into the rivers and land, resulting in contamination of water resources and soils. It can be seen in the study by Mkodzongi (2020) that unregulated artisanal mining practices causes the pollution of aquatic environments and other related problems in Bindura.

1.2 Research Problem

Although there is an increasing amount of literature on the effects of artisanal mining, there is also a need for more detailed studies on the effects of (ASM) on the environment and the livelihoods of people in Bindura District. In the words of Spiegel (2022), it is unclear how much of the environmental problems in Bindura District can be attributed to the activities of artisanal miners and how much they affect their livelihoods, and such information would be very helpful in formulating better policy decisions that promote sustainable economic development in Bindura District.

1.3 Research Objectives

1.3.1 The Main Objective

The aim of the study is to assess the impacts of artisanal mining on the environment and livelihoods in Bindura District, Zimbabwe.

1.4 Specific Objectives

1. To characterize the nature, scale and distribution of artisanal mining activities within the Bindura District.

2. To evaluate the environmental consequences caused by artisanal mining activities on land and water resources in Bindura district.

3. To analyse the socio-economic effects of artisanal mining on the livelihoods of local communities in Bindura district.

4. To identify opportunities for sustainable artisanal mining practices and recommend strategies for mitigating negative environmental and social impacts.

1.5.1 Research Questions

1. What is the nature (methods used, legality of operations and primary minerals extracted), scale (estimated population involved) and distribution (geographic locations of the main hotspot) of artisanal mining activities within the district?

2. What and to what extend are the environmental impacts of artisanal mining in Bindura district?

3. In what ways does the artisanal mining affect the socio-economic livelihoods of local communities in Bindura district?

4. What are the strategies that can be implemented to promote sustainable artisanal mining practices in Bindura District.?

1.6 Justification

Artisanal mining is a significant economic activity in Bindura District, providing income opportunities for many locals but it also contributes to environmental degradation and health risks. This research is therefore going to inform policymakers and stakeholders about the need for regulations, environmental management, sustainable mining practices and support for artisanal miners to mitigate the negative impacts and enhance the benefits of mining.

1.7 Definitions of Key Terms

Artisanal mining: According to Agwa et al (2018), Artisanal mining refers to small scale, informal or traditional mining activities carried out by individuals or small groups often using simple tools and techniques.

Environment: Barnetts (2024) refers environment to the natural surroundings and ecosystems, including air, water, soil, vegetation and wildlife.

Livelihoods: Livelihoods refer to the means by which individuals or communities make a living, including income, employment, and access to resources (Chambers and Conway, 2022).

Small scale mining: According to Seccatore etal (2022), small-scale mining refers to mining activities that are carried out on a small scale, often with limited capital, technology and expertise.

Impact: Marufu (2023) defines an impact as the effects or consequences of artisanal mining on the environment and livelihoods which can be positive or negative.

Informal mining: According to Pradhan et al. (2018), informal mining refers to mining activities that are not formally regulated or licensed by the government often operating outside of formal laws and regulations.

1.8 Organization of the study

This study has chapter one which include introduction, background of study, research problem, justification, aims and objectives, research questions, definition of terms, organisation of the study and conclusion. Chapter two which consist of literature review, chapter three which include methods and data analysis, chapter four which has results, research findings and discussion and chapter five which has summary, conclusion and recommendations.

1.9 Chapter Summary

This chapter managed to bring out the background of study, research problem, justification, aims and objectives, the research questions, definition of key words and the organization of the study. The next chapter will be looking at the literature review.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

The chapter reviews literature on the assessment of the impacts of artisanal mining on the environment and livelihoods. It also conceptualize artisanal mining and outlines relevant literature on artisanal mining. The chapter also looked at the theoretical framework guiding the study. This section also gave a detailed concept on artisanal mining by providing literature based on the research questions and objectives.

2.1. Conceptualizing Artisanal Mining.

The Minamata Convention on Mercury defines artisanal and small-scale gold mining as mining carried out by lone miners or small businesses with restricted capital investment and output (United Nations Environment Programme, 2022). McDermott (2017) posits that the International Labour Organisation characterizes small-scale and artisanal mining as labour-intensive, with little and rudimentary mechanization. Artisanal and small-scale mining (ASM) activities are mainly characterized by the minimal use of machinery or technology, operation with or without legal mining title or valid contract with the title holder, low productivity, inadequate safety measures, healthcare and environmental protection and high seasonality linked to economic insecurity (Chari, 2020).

2.2. Theoretical Framework.

The study connects Garrett Hardin's (2018) tragedy of the commons to the Bindura District mining communities, where people are taking advantage of natural resources for their gain. Nonetheless, the study looked into the connection between artisanal mining and environmental sustainability in light of the legalization of small-scale mining. Ells (2018) contends that the tragedy of the commons is often brought up when people discuss environmental issues. For example, in the case of artisanal mining, if it provides an income, then each miner would have his or her own best

interest in mind and try to mine as many minerals as possible even if all the other miners are doing the same thing. As this behaviour continues, the shared resource (the mineral) is eventually depleted and the group as a whole of the community population suffers (Ells, 2018). Another example often cited is the deforestation of the existing forests as clear-cutting of trees for mining or development may directly benefit those, who own and use the land but the cost of losing that forestland is more widely distributed (Ells, 2018). He further contends that pollution is also similar as it may be beneficial to practice artisanal mining each day using different types of chemicals such as mercury causing water pollution and other environmental problems, but because the water is common and shared by everyone, the overall public has to deal with that pollution each person contributes.

Drew (2023) asserts that the Tragedy of the Commons is an economic theory that explains how individuals frequently use natural resources for their benefit without taking into account the needs of a community or society as a whole. A depletion of natural resources results when many people just think about their well-being. This has detrimental effects on everyone. Understanding this economic theory necessitates having a working concept of the commons, that includes any natural resources that are not privately held by a person or business (Prior, Giurco, Mudd, et al.,2022). Instead, the whole public can make use of these resources. As observed by Drew (2023), these may include minerals, open pasturelands, wood, oil, the oceans, the atmosphere, fish and wildlife and several other shared resources. People frequently misuse resources that are freely available to them, as The Tragedy of the Commons explains. Frequently, they overlook the idea that overuse of the resource will have detrimental repercussions on everyone involved, including themselves.

Drew (2023) further drives home the fact that if everyone acts in their own best interests, the resource as a whole approaches exhaustion, indicating a deficiency in stewardship of the common good. Several remedies have been put out to counteract the unfavourable effects of The Tragedy of the Commons. As individuals band together to protect resources for the benefit of all, solving this issue generally call for cooperation and teamwork. The government's ability to regulate and tax people can limit their impact on particular resources. To prevent people from using other resources excessively, organizations or individuals may be granted statutory or informal property rights, as observed by Woznick and Buchs (2017). In addition to explaining the endogenous dynamics of ASM, the researcher expects this model to identify and evaluate potential leverage

strategies to mitigate the negative effects of ASM that are now in place and to advance ASM as a driver of sustainable development and economic growth.

The tragedy of the commons is a crucial theory in understanding artisanal mining because it explains the environmental degradation and resource depletion that often accompany unregulated access to common resources, like gold deposits. In the case of Zimbabwean artisanal mining industry, people tend to seek quick gains without worrying about the sustainability of the processes used, leading to environmental destruction and resource wastage. It makes this theory more applicable than other theories in this setting because artisanal mining usually involves extraction from common property such as gold and watersheds whose rights have not been clearly demarcated. Miners only think about themselves and ignore the interests of the wider community and environmental conservation.

The theory of tragedy of commons emphasizes the importance of collective efforts in addressing resource management issues. Artisanal mining would therefore call for the involvement of the community and the management of these resources through joint endeavours by stakeholders in government, mining companies, and the communities concerned.

2.3 Nature of Artisanal Mining

2.3.1 Artisanal Mining Globally

As per ILO (2019), the artisanal mining practice is prevalent in many places around the world. Approximately, 40 million people are involved in artisanal mining practices worldwide. Hilson (2017) defines artisanal mining as an activity that is small-scale, labour-intensive, and unorganized mining activity, which employs primitive methods of mining and primitive mining equipment. Artisanal mining activities are predominant in developing countries especially Africa, Asia and Latin American countries (Bebbington et al., 2018). The environmental impacts of artisanal mining activities include deforestation, soil erosion, and water contamination (Kativhu et al., 2018). Artisanal mining activities pose significant threats to the health of mining personnel such as mercury poisoning and lung diseases (Nyamukondiwa et al., 2020). Social conflicts among miners and surrounding community members have been reported in several cases of artisanal mining

activities (Mabugu et al., 2019). According to Chikweche et al. (2019), artisanal mining activities produce substantial revenue for household members and contribute to poverty reduction.

Attempts at regulating artisanal mining have been going on in various countries, and they have had varied success levels (Hilson, 2019). Artisanal mining contributes to achieving several SDGs, which include poverty alleviation, quality jobs, and sustainable environment (UNDP, 2019). There are numerous problems facing artisanal mining, among which the lack of financing, technology, and market access is notable (Bebbington et al., 2018).

2.3.2 Artisanal Mining in Africa

It should be noted that artisanal mining exists widely all over the continent of Africa, and millions of people are involved in such activities. There are data that in sub-Saharan Africa, there exist not less than eight million miners involved in ASM directly, with not less than 45 million people dependent on those miners for a living (Banchirigah, 2018). In the Democratic Republic of the Congo, miners are responsible for approximately 20% of the production of cobalt used in such global sectors as electronics (Sovacool, 2019). ASM is quite common among economies in Africa and is mainly associated with poverty (Hilson, 2017). It has been calculated that around 13 million people in 30 countries in Africa work in small-scale mining and are mostly represented by women and children (International Labour Organization, 2019). Moreover, another 80 to 100 million people worldwide depend on small-scale mining for some of their livelihood elements (Bebbington et al., 2018).

Nevertheless, ASM may be highly detrimental for the environment as well as people's health due to inefficient mining and processing procedures (Kativhu et al., 2018). According to Hilson (2019), the practice of ASM is regarded by the majority of African governments as a criminal one, which prevents any legislative frameworks from being established. Thus, the lack of security and regulation makes poor practices even more prominent while at the same time depriving miners of possible advantages and causing problems in the form of conflicts (Bebbington et al., 2018). Moreover, local governance is poorly developed, which leaves artisanal and small-scale miners in neglect, leading to further conflicts over land and resource distribution, especially in places with native tribes (Madzivire, 2020).

2.3.3. Nature of Artisanal Mining in Zimbabwe.

In Zimbabwe, the sector has played an integral part in developing the economy, considering that it contributes over 60 percent of the country's earnings from exports, more than 13 percent of GDP, and brings in direct investments into the country (Zimbabwe Ministry of Mines and Mining Development, 2020).

The history of artisanal mining in Zimbabwe is traced back many years ago, dating from the pre-colonial era, when locals were involved in mining activities for precious metals such as gold, copper, and iron (Machingaidze, 2018). Since then, the sector has evolved with changing socio-economic and political environment within the country. At present, artisanal miners who are referred to as 'makorokoza' occupy a vital part in Zimbabwe's gold mining operations, making a considerable contribution to gold production.

However, artisanal mining in Zimbabwe also brings challenges, including severe environmental pollution from mercury and other hazardous chemicals used in gold extraction (Kameta, 2019). Miners face multiple health risks from toxic exposure and unsafe working conditions (Nyamukondiwa, 2020). Additionally, artisanal mining has been linked to violent groups known as maShurugwi. However, it is important to recognise that maShurugwi is often a pejorative term broadly applied to artisanal miners, reinforcing negative stereotypes and stigma (Madzudza, 2019).

2.4. Scale and Distribution of Artisanal Mining Activities within Bindura.

Bindura District in Mashonaland Central Province of Zimbabwe has for the past two decades experienced a sharp decline in subsistence agriculture as a result of unemployment and recurring droughts (Taylor 2018). This phenomenon has forced many households to diversify into gold mining along the Mazowe and Bindura rivers and in disused mines (Kamete 2017). In the process of diversification, Chari (2020) view ‘the poor as both the victims and agents of environmental degradation forced to engage in unsustainable activities to meet short term survival needs’. Artisanal mining has received a boost in Bindura in the last decade because of new government policies, through the Ministry of Small Scale and Medium Enterprises, that promote small-scale mining as miners are encouraged to peg claims and operate legally. However, such policies have overlooked key issues, such as equipping and training small-scale miners in a bid to help minimise the adverse impacts on the environment.

2.5. Environmental Consequences of Artisanal Mining Activities on Land and Water Resources.

The environmental consequences of artisanal mining are severe, with mercury pollution from gold mining being a major concern (UNEP, 2023). Mercury is used to extract gold, and its release into the environment can have devastating effects on human health and the ecosystem (Nyamukondiwa et al., 2020).

In Africa, artisanal mining is a significant economic activity, with millions of people relying on it for their livelihoods (Bebbington et al., 2018). Yet, the impact of artisanal mining in Africa on the environment is quite serious, with deforestation, soil erosion, and water pollution being some of the main issues (Kativhu et al., 2018). This applies to Zimbabwe, where artisanal mining causes environmental problems such as mercury pollution and the extinction of some species (Nyamukondiwa et al., 2020).

The use of artisanal mining causes deforestation, which then results in biodiversity loss and disrupts the ecosystem (Kativhu et al., 2018). He further stated that soil erosion may be experienced, hence low agricultural productivity and increased water sedimentation. Water pollution is another impact associated with artisanal mining, threatening the life of humans and wildlife (Nyamukondiwa et al., 2020). Artisanal mining may lead to biodiversity loss in certain regions, especially when there is conservation value (Hilson, 2019). It is important to consider promoting sustainable artisanal mining activities.

In Zimbabwe, diversification into artisanal small-scale gold mining especially in Bindura district, whilst providing employment and livelihoods to many, pose ecological challenges. Artisanal gold mining in Bindura District depends heavily on water for panning processes. The water challenges are made worse by the fact that the district is a water catchment area for Bindura Metropolitan Province of development and surrounding areas (Ncube et al. 2017). According to Chirwa (2020), the long-term sustainability of a catchment area and its rivers highly depends on the type and volume of economic activity taking place within the catchment area. Dams supply water to these areas and according to the Food and Agriculture Organisation of the United Nations (FAO) (2020),

the dams are along three major rivers where alluvial gold panning activities are concentrated. The river system has been identified as a key variable negatively affected by gold panning. Drying up of dams and rivers in Bindura District has been blamed largely on siltation (Zimbabwe National Water Authority [ZINWA] 2017). Siltation of rivers 'reduces river conveyance and the storage capacity of reservoirs, which in turn will make several areas prone to flooding.

Gold panning processes on the river banks, beds and the surrounding areas discharge huge amounts of loose silt and heavy metals into the river system. Eventually these are washed into the dams, increasing the risk of siltation, flooding and drying up of water reservoirs (Shoko 2022). The effect on the storage capacity has already been felt in and around the district. Bindura is the worst hit by water shortages as a result of reduced storage capacity of the dams supplying water to the city. Bindura's water consumption stands between 134 000 m3 and 140 000 m3, of which 58% come from the Bindura catchment area (Bindura City Council 2025).

Mercury is used for gold amalgamation in artisanal mining. The amalgamation process transforms elemental mercury into methyl mercury (United Nations Environment Programme [UNEP] 2022). Methyl mercury, one of the most toxic organic compounds, is a powerful neurotoxin that works its way up the food chain through bioaccumulation. This poses a threat to the health of animals, humans (International Council for Science 2017) and aquatic life (Tunhuma 2017). Mercury is also poisonous when inhaled (FAO, 2017), as it causes lung cancer and skin disease. The mercury used by panners is also discharged into ecosystems in an abusive manner (Pfeiffer, 2018).

In the current research literature, ASGM has resulted in extensive deforestation, soil erosion, and water pollution, hence causing substantial ecological harm and health hazards to the people living near the mining zones (Nyakuwanika and Panicker, 2025). Mining processes have destroyed ecosystems by means of land clearing, which triggers soil erosion, siltation, and soil compaction. Water pollution has also emerged as a result of mercury and cyanide chemicals used in extracting gold, adversely affecting ecosystems, flora, and water sources. In some cases, water pollution has emerged due to the presence of mercury in water sources used for agricultural purposes (Kohio et al., 2024). Ecosystems have also been fragmented and degraded, disrupting migratory paths and fisheries. In addition, air pollution, associated with ASGM activities, contributes to global warming, and noise pollution caused by stamp mills and blasting leads to health risks and

migration of wildlife. Finally, ASGM destroys the aesthetic value of landscapes, leaving open mines and sand mounds.

2.6. Socio-economic impacts of artisanal mining on the livelihoods of local communities.

Artisanal mining is a significant economic practice, with approximately 40 million individuals involved in the industry worldwide (ILO, 2019). The socio-economic impacts of artisanal mining are numerous, with both positive and negative impacts on communities (Bebbington et al., 2018). Artisanal mining practices can positively affect communities by creating jobs and earning money (Hilson, 2017). On the contrary, artisanal mining practices may negatively affect the socio-economic well-being of communities, such as causing environmental destruction, health hazards, and social conflict (Kativhu et al., 2018; Nyamukondiwa et al., 2020).

In Africa, artisanal mining is an important economic practice for thousands of individuals who rely on it for their livelihoods (Bebbington et al., 2018). It contributes significantly to socio-economic development through poverty alleviation and boosting economic growth (Hilson, 2017). Unfortunately, it also has negative socio-economic impacts on communities, such as environmental degradation, health problems, and social conflicts (Kativhu et al., 2018; Nyamukondiwa et al., 2020). Moreover, artisanal mining activities affect the livelihood of communities across the globe, particularly in Africa.

Even more importantly, artisanal mining provides job opportunities for local communities, hence promoting poverty alleviation and economic development (Hilson, 2017). According to Bebbington et al (2018), artsanal mining brings money to the local community, making their lives better as well as promoting economic development. It also helps in reducing poverty because people in these communities may not have other means to earn a living. However, artisanal mining has several disadvantages associated with it such as environmental degradation (Kativhu et al., 2018). These include deforestation, soil erosion, and pollution of water bodies. In addition, artisanal mining can pose serious health risks to local communities in form of diseases like mercury poisoning (Nyamukondiwa et al., 2020). Social conflicts have also been noted to arise due to artisanal mining because of access to land (Madzivire, 2020).

Gold mining in its artisan form represents an important revenue stream for many communities in Zimbabwe, especially those that are located in rural areas and lack other means of formal employment (Banchirigah, 2018). In a number of cases, artisanal gold mining represents an important source of income that allows households to meet their basic necessities including food, education, and health care (Hilson, 2022). Moreover, it enables people, especially women and youths, to engage in self-employment without being limited by time constraints (Kadir et al., 2023). Many miners are attracted by the fast revenue streams associated with gold mining, especially during times of economic downturn when other sources of employment are not available (Spiegel, 2017).

The informal nature of AGMs frequently results in miners operating beyond legal boundaries, consequently restricting their access to resources, support, and protections (Banchirigah, 2018). Miners lacking formal recognition may face challenges in securing land and resource rights, rendering them susceptible to exploitation and disputes over land use (Hilson, 2022). Enhancing the positive impacts of AGM on livelihoods requires the implementation of legislation that promotes formalization, provides training and resources for sustainable practices, and ensures the active participation of local communities in decision-making processes related to mining operations (African Union, 2017; Kadir et al., 2023).

2.7. Opportunities for sustainable artisanal mining practices.

Despite the negative impacts often associated with Artisanal and small scale mining, the sector can have a variety of positive impacts (Hilson, 2022). Artisanal and small scale mining ASM is labour-intensive, offering more direct and indirect job opportunities than large-scale operations, and revenues generated can increase local purchasing power and benefit economic activity in a range of sectors at the local level (Hilson and McQuilken, 2016). The positive role that ASM can play was explicitly recognised in the African Mining Vision 2050, which commits African countries to "harnessing the potential of ASM to improve rural livelihoods, to stimulate entrepreneurship in a socially responsible manner, to promote local and integrated national development as well as regional cooperation" (African Union, 2017).

A corporate delegate at the 2022 African Mining Indaba ascribed the difficult relationship between large mining corporations and ASM to two factors (CASM, ICMM,Dev, 2022). Firstly, ASM

mining is often linked with organised criminal networks and powerful local interest groups who oppose efforts by mining corporations to assist in developing and legalising ASM mining (Spiegel, 2019). Secondly, large mining companies fear that efforts to assist ASM miners will only lead to uncontrolled inflows of ever greater numbers of fortune seekers (CASM et al., 2022).

Despite these challenges, various corporate delegates recognised that successful partnerships between ASM and Large scale mining LSM are possible and necessary (Hilson and McQuilken, 2019). Large mining companies can contribute to safer and more productive ASM by assisting ASM miners to form cooperatives that can access land legally, by sharing health and safety expertise and introducing new technologies (CASM et al., 2017).

2.8. Strategies for mitigating negative environmental and social impacts

Improving resilience in mining communities affected by AGM necessitates the implementation of initiatives aimed at diversifying income sources. Training and resources for alternative livelihoods, including agriculture, small-scale enterprises, and eco-tourism, help communities reduce their dependence on mining as their primary source of income (Hilson, 2022; Kadir et al., 2023). Diversification helps to strengthen economic stability and reduce risks due to volatility in the prices of gold as well as the demand in the market (Spiegel, 2019). This strategy ensures that households have several options when it comes to generating incomes.

Engagement of the local population in the decision-making process is very important because it will help build resilience while ensuring there is ownership of the community. Discussions held among the community members about mining and its implications lead to ownership and responsibility for resource management (African Union, 2017). Providing platforms for discussion through organizing community meetings or other forums can ensure that the people air out their views (CASM, ICMM, & IFC CommDev, 2018).

Combining education campaigns with the resilience process provides community members with vital information and skills needed to fight for their rights and make proper decisions (Hilson and McQuilken, 2018; Kadir et al., 2023). Understanding the environmental and health impacts of AGM along with the significance of sustainable practices could help community members build a stewardship culture that ensures economic prosperity through environmental sustainability

(Miththapala, 2018; Shoko, 2022). These efforts help build a solid base for resilience, which enables mining communities to face AGM challenges.

2.9. Chapter Summary

The chapter outlined the literature on the assessment of the impacts of artisanal mining on environment and livelihoods in Bindura District, Zimbabwe. The section conceptualized artisanal mining and outlined relevant literature on artisanal mining. The chapter also looked at the theoretical framework guiding the study. It also gave a detailed concept on artisanal mining by providing literature based on the research questions and objectives. The next chapter outlines the research methodology.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter outlines the research methodology that was used to assess the impact of artisanal mining on the environment and livelihoods in Bindura District. The research adopted a qualitative approach to provide a comprehensive understanding of the complex relationships between artisanal mining, livelihoods and environmental degradation. The chapter outlines the research study area, population, sampling, data collection methods, data analysis, validity and reliability.

3.1. Description of the study area

The study was conducted in Bindura District which is located in Mashonaland Central Province, Zimbabwe. Bindura is well known for mostly artisanal mining which is rampant in the area and region. The district has rich mineral deposits which include gold and nickel. The availability of gold has attracted both large-scale and artisanal miners. The economic activities that are mainly associated with the district are mining, agriculture, and livestock production and have a population of approximately 145,000 (ZIMSTAT, 2022). Bindura District spans roughly from -16.95° to -17.65° South and 31.05° to 31.65° East. Bindura District is located about 88 km northeast of Harare. It is bounded by Mazowe District to the west, Shamva to the east, and Guruve to the north. It has a subtropical highland climate, classified as Cwa under the Köppen system. It is also described as a temperate/mild tropical savanna climate with distinct wet and dry seasons. Rainfall is highly seasonal and increasingly variable due to climate change. Droughts and mid-season dry spells are common, impacting agriculture. Most of Bindura falls in Natural Region IIa and IIb. This means relatively reliable rainfall and good soils. Figure 3.1 below shows the study area.

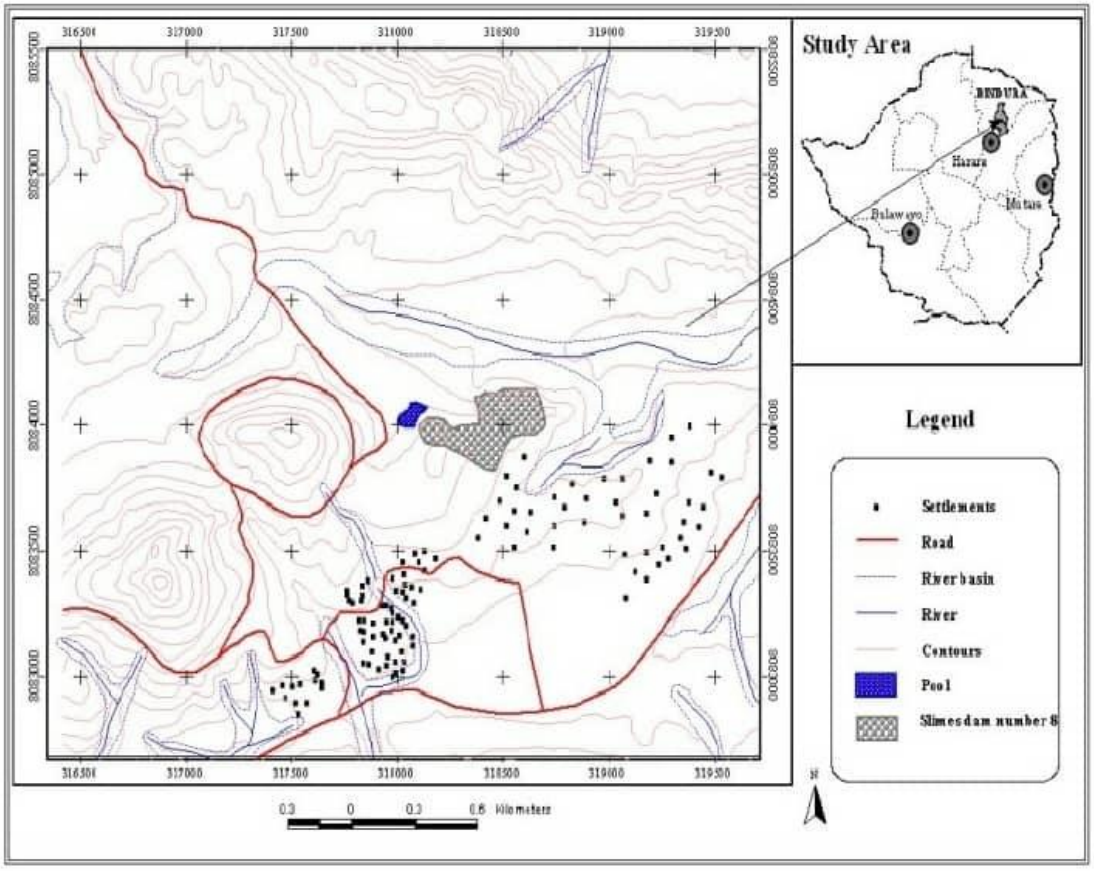

Figure 3.1: Location of Bindura District in Zimbabwe

Bindura District, shown above is a resource-dependent community, where the local economy is heavily reliant on mining of natural resources including gold and chrome. The district's mining sector is mainly dominated by artisanal, small-scale, low-tech operations mining using rudimentary tools and techniques.

3.2 Population and sampling

This study consists of the individuals from Bindura District. This comprise of all stakeholders involved in or affected by artisanal mining in Bindura, including Bindura City Council officials, local government officials, community leaders, and community members. This population's characteristics are diverse, comprising of young and old aged participants, educated and uneducated, employed and unemployed participants. The majority of the population is the artisanal

miners who mainly rely on mining for survival and have limited access to formal employment opportunities.

Furthermore, the researcher used purposive sampling to identify study participants. Patton (2022) argues that purposive sampling is the selection of participants based on their relevance to the study questions based on their ability to provide rich detailed insights. In this study, the choice of participants was be guided by the research objectives and the study aim which is to assess the impacts of artisanal mining on environment and livelihoods in Bindura District, Zimbabwe. The selection of study participants was based on their knowledge about artisanal mining and its impacts on the environment and local communities. The study participants were selected from artisanal miners, local community members, and government officials/environmental experts. The artisanal miners were selected due to their involvement in mining activities in Bindura taking into consideration their experience. Community members were selected based upon their proximity to mining areas and their experience with the impacts of artisanal mining on their livelihoods and the environment. For this research work, government personnel and environmentalists were selected due to their involvement in the regulation and management of artisanal mining operations in the Bindura District. In total, there were 50 subjects selected in this study; 30 artisanal miners, 10 local community members, 5 government personnel, and 5 environmentalists. The number of subjects selected was based on the criterion of data saturation where further data collection will not yield any new information from the interviews.

3.3 Methods of data collection

Multiple techniques of qualitative data gathering were used in the study, including semi-structured interviews and focus group discussions. The purpose of this approach was to ensure an in-depth understanding of the topic of interest.

3.3 Semi-Structured Interviews

Semi-structured interviews were used to collect data. The semi-structured interviews involved conducting in-depth, face-to-face interviews using an interview guide that outlines the topics to be covered. The interviews were audio-recorded and transcribed verbatim. The interview guide was pre-tested with a small sample of participants to ensure that the questions were clear and relevant

to the research objectives. The strengths of semi-structured interviews include their ability to provide in-depth insights into participants' experiences and perceptions.

3.4 Focus Group Discussions

Focus group discussions were conducted to gather rich insights from different participants to obtain wider opinions about the topic under study and understand their experiences and perceptions and discussions were audio-recorded and transcribed verbatim. This method was chosen because it allows the collection of data from multiple participants simultaneously, enabling the researcher to gather a range of perspectives timeously. The strengths of focus group discussions include their ability to provide insights into group dynamics and social norms.

3.5 Methods of data analysis

For the analysis of data generated through semi-structured interviews, focus group discussions, and document analysis, thematic analysis and content analysis were used in this study. Thematic analysis entails finding and classifying the common themes in data (Braun and Clarke, 2024). On the other hand, content analysis includes analyzing systematically the contents of textual materials to uncover themes (Krippendorff, 2023). There were various steps that were involved in the analysis of data, which included cleaning, coding, and categorizing the data. In the first place, cleaning of data was performed by eliminating all irrelevant data. Cleaning of data was followed by coding, where the codes and themes from data were extracted through the use of NVivo software. Codes were put in categories and sub-categories.

Thematic analysis was used to examine the linkages, relationships, and trends within the data by detecting the patterns and themes that arise from the participants' experiences and perspectives. This was done by conducting the analysis through a systematic coding and categorization process of the data, for example, in terms of content found within reports or proposals among other documents. The employment of NVivo software helped in the analysis of the data as the researcher could easily organize the large amount of data. Moreover, the software allowed the identification of linkages, relationships, and patterns in the data, as well as representation of the findings using diagrams and charts. Methods used in data analysis uncovered linkages, relationships, and trends in the data by offering a rigorous way of analysing the data.

3.6 Reliability and validity

In this case, the reliability and validity of this study was guaranteed by a number of ways. In terms of ensuring reliability, the researcher guarantees that the methods used to gather data were reliable. For instance, before conducting the semi-structured interview, the interview guide was tested on a small number of participants to determine whether the questions would be useful for the researcher's purposes. Besides, when conducting focus groups discussion, the researcher made sure that it followed a standard procedure. Moreover, in this research, the researcher was able to keep a record of all the processes involved in collecting data, including the date, time, and location where the interview and focus group discussions were conducted.

On the other hand, to achieve validity, the researcher ensures that the data collection methods were accurate and truthful. For example, the researcher used multiple data collection methods, including semi-structured interviews and focus group discussions to triangulate the data and ensure that the findings are accurate. The researcher also ensures that the participants were aware of the purpose of the study and that their participation is voluntary. This helped to ensure that the participants provide honest and accurate information.

The researcher also used member checking to ensure the validity of the findings. This involves taking the preliminary findings back to the participants to ensure that they were accurate and truthful. She also used peer debriefing, where colleagues review the data analysis process and provide feedback on the findings. The use of nvivo software also helped to ensure the reliability and validity of the findings. The software enable the researcher to manage and analyse the data systematically, reducing the risk of errors and biases. By taking these measures, the researcher managed to ensure that the findings were reliable and valid which provides an accurate and truthful account.

3.7 Chapter Summary

In summary, this chapter explained the methodology employed in evaluating the impacts of artisanal mining on livelihoods and the environment in Bindura District. This study utilized a qualitative research approach in providing an in-depth insight into the intricate interrelationship between artisanal mining, livelihoods and environmental destruction. This chapter provided an outline of the research location, population, sampling, data collection techniques, data analysis, validity and reliability.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter presents and analyses the data collected. The chapter is structured according to the four study objectives. Data were collected through 30 semi-structured interviews and 4 focus group discussions involving 50 participants. Thematic analysis was conducted using NVivo 14, and findings are presented thematically, supported by direct participant quotes, tables, and linkage to existing literature.

4.1. Demographic Profile of Participants

The study engaged 50 participants from Bindura District. Table 4.1 summarizes their demographic characteristics.

Table 4.1: Demographic Characteristics of Participants

Characteristic	Category	Frequency	Percentage
Sex	Male	38	76%
	Female	12	24%
Age	18-25	8	16%
	26-35	15	30%
	36-45	14	28%
	46-55	9	18%
	56+	4	8%
Role	Artisanal Miner	30	60%

	Community Member	10	20%
	Government/Environmental Official	5	10%
	Community Leader	5	10%
Mining Experience	<2 years	7	14%
	2-5 years	18	36%
	>5 years	25	50%

The sample was dominated by males aged 26-45, reflecting the gendered nature of artisanal mining in the district. Most participants had over 2 years of experience, providing credible insights into changes over time.

4.2. Nature, Scale and Distribution of Artisanal Mining in Bindura District

4.2.1. Methods and Tools Used

Artisanal mining in Bindura District is characterized by manual, low-mechanized methods that reflect both the informal nature of the activity and the material constraints faced by miners. Participants consistently described extraction and processing as labour-intensive, relying on basic hand tools such as picks, shovels, hammers and chisels, with little to no use of machinery. One miner explained,

> *Tinoshandisa mapiki nemafoshoro kuchera pasi. Kana tasvika paore, tinoipwanya nemanyundo tozoitakura mumabhegi toenda nayo kurwizi kundogeza. "We use picks and shovels to dig down. When we hit ore, we break it with hammers and carry it in sacks to the river to wash".*

The absence of mechanization was attributed to financial barriers, as a focus group participant noted,

Hapana michina pano. Kana uine mari yetiradzikiri nepombi, wava 'sabhu'. Vazhinji vedu tinoshanda nemaoko. "There are no machines here. If you have money for a generator and pump, you are already a 'boss'. Most of us work with our hands".

For the extraction of gold, mercury amalgamation still prevails as the most common approach, despite its risks, as quoted by the miners who said,

Kune goridhe, tinosanganisa ivhu nemekiyuri mundiro, tozoipisa. Utsi hwakaipa, asi ndiyo nzira yatinoburitsa nayo goridhe. "For gold, we mix the soil with mercury in a bowl, then burn it. The smoke is bad, but that is how we extract the gold"'.

These interpretive insights reveal that the methods employed have less to do with efficiency and much more to do with affordability and availability. Physical labour plays an important role in the process of mining, and the ownership of machines is used as a symbol to distinguish common miners from the relatively wealthy. The continued use of mercury in the mining process demonstrates that miners prefer quick gold gains over their health and the environment in the absence of safer practices and machinery that would cost more money.

The research findings are in line with existing knowledge about ASM in Sub-Saharan Africa. McDermott (2017) and Hinton et al. (2023) note that ASM practices involve low technology and high labour intensity as a result of financial limitations and exclusion from official mining processes. Likewise, Nyamukondiwa et al. (2020) point out the existence of hazardous mercury in mining sites in Zimbabwe, and Mutemeri et al. (2021) claim that most of the artisans in Zimbabwe do not work with official machinery.

From the perspective of Hardin's Tragedy of the Commons, the tools used in Bindura clearly illustrate the negative consequences that arise from the absence of regulation and open access to resources, which result in rational decisions on an individual level. Being considered as open-access resources, the mining sites provide little to no oversight, and the miners seek to use what they can get in their quest for maximizing profits. As a consequence of this, the main means of mining is mercury and manual work. While this approach may yield good results for individuals involved, it creates negative outcomes such as environmental damage, mercury pollution, and potential risks to miners' health. The lack of mechanical equipment is not merely because people

in Bindura cannot afford it; rather, there is no incentive for any individual miner to improve the process if no one else follows his or her example.

4.2.2. Minerals Extracted and Hotspots

The practice of artisanal mining in the Bindura District was noted to be concentrated spatially by mineral type, and the mineral types which were referred to as hotspots in this study. This is because these minerals are easily available and accessible. It was found out that the commonly mined minerals in the district include gold, but there are also chrome and sand mines which are practiced in some particular wards. Mining takes place near river beds, and also around abandoned or partially operating mines from where ores can be retrieved. The hotspots in the district include Mazowe Riverbanks, Trojan Mine Area, Shamva Road Belt, and Ran Mine Periphery. According to one miner,

Goridhe ndiro riri kutsvagwa nemunhu wese pano. Kana ukanzwa vanhu vachichera, 90% yenguva ndeyegoridhe. "Gold is what everyone is after here. If you hear people digging, 90% of the time it's for gold".

One of the participants interviewed in the focus group discussion in Ward 12 stated,

"Mavhu akatiri nechete chete kwemvura yeMazowe yapasi ndiku vamwe vafadzanya kuone. Kuona mumwaka wakuridza nekuvanwa, kana kunze pangu kumuna May uye kusvika October, mumva mavhu anenge avho avanhu." "Gold extraction is done at Mazowe River because the soil there is rich in gold. During the dry period, when the month ranges from May to October, the riverbank has lots of people."

A key informant also noted,

"Mavhu akati kure chete kuTrojan neRan mines dumps yakakushinga. Vani vadzoka kupfungwa kwedu vakoziva kuti vachingi zvinhu zvakachinga." "Old Trojan and Ran mines

Interpreting the data, one can conclude that mineral extraction is unevenly distributed in the district depending both on resource availability and accessibility. As for the mineral type, the choice is made based on gold because of its valuable nature, ease of processing and liquidity. The concentration of miners close to rivers and abandoned sites shows that miners respond to

geological factors rationally; however, at the same time, there is no formal distribution and control mechanism involved. It is worth adding that the seasonality aspect clearly shows that the environment directly influences the intensity and scope of the activity. This conclusion is aligned with previous research dedicated to the ASM practices in Zimbabwe and the broader region. According to Mutemeri et al. (2021), gold mining prevails within the Zimbabwean ASM sector because of its valuable nature and straightforward extraction procedures. At the same time, Hinton et al. (2023) point out that miners operate mostly near alluvial deposits and abandoned mines, which allows them to overcome any barriers of entrance. Seasonality of mining operations has been noted by Nyamukondiwa et al. (2020). The pattern that prevails in Bindura, thus, reflects the dynamics of ASM mining operations in general, which involve extraction in response to the presence of mineral veins and water channels where there are no concessions.

In application of Hardin's Tragedy of the Commons, the prevalence of mining activities in certain spots represents a situation whereby open access leads to the over-exploitation of a common resource. This happens since riverbanks and abandoned mine fields act as common properties where there is lack of strict enforcement mechanisms, miners feel compelled to exploit the common resource as quickly as possible to beat other miners. Exploitation is further heightened by the fact that the common resource being explored is gold whose high monetary value makes miners act selfishly.

4.2.3. Scale of Participation

The participation in artisanal mining in Bindura District is diverse and cuts across full-time, part-time, and opportunistic miners who primarily come from within the community. The practice engages many youths and men who do not have any other form of income source, while women and other community members engage in panning activities. Artisanal mining peaks during the dry season when the level of water in the rivers becomes lower and makes the shafts safe for mining, although even during the rainy season, some remain active despite the floods in other areas. One artisanal miner reported that,

"Vazhinji vedu pano tiri majaya. Kana usina basa muguta, unouya kurwizi kundochera." ("Most of us here are young men. If you don't have a job in town, you come to the river to dig")

In a focus group discussion, one participant said that,

"Vamwe vanochera mazuva ese, vamwe vanongouya kana vachida mari yechikoro kana yechikafu. Zvinoenderana nemwaka."("Some people mine every day, others only come when they need money for school fees or food. It depends on the season.")

The above quote was contributed by one of our key informants,

"Women and even elderly men pan in the rivers, but the difficult digging part is undertaken by the youths".

Analytically speaking, these answers indicate that participation is quite flexible and depends on immediate household requirements. For some households, mining is their sole livelihood strategy while others consider it as an additional source when the need arises. Participation by various demographic categories also denotes low entry costs into the practice as well as the lack of other sources of employment for many people in the district. In terms of numbers, it is clear that artisanal mining serves as an important informal economy in Bindura, generating income for many residents.

4.3. Environmental Consequences on Land and Water Resources

4.3.1. Deforestation and Land Degradation

Deforestation and land degradation were cited as some of the direct effects of artisanal mining in Bindura. Removal of vegetation for sinking shafts, setting up of panning grounds and opening of access pathways was seen to have occurred in all areas of mining activity, with old shafts lying idle and exposed top soil left degraded without any rehabilitation measures being undertaken. Deforestation led to soil erosion, degradation of farmland and alteration of the landscape, especially near river banks and areas that were formerly mined. One miner said,

"Patinovhura nzvimbo itsva, tinotanga kutema miti kuti tikwanise kuchera nekumisa zvinhu zvedu. Kana tapedza, tinoingosiya yakadaro." "When we open a new site, we cut down trees first so we can dig and set up. After we finish, we just leave it".

A focus group member said,

"Ivhu ratinoshandira harichagoni kushandiswa pakurima zvakare. Ivhu racho rasununguka uye kana mvura yanaya, zvese zvinokukurwa." "The land where we mine cannot be used for farming anymore. The soil is loose and when it rains, everything washes away".

Another informant further noted,

Unoona nzvimbo huru dzisina miti pedyo neRwizi rweMazowe. Nzvimbo idzodzo dzaimbove nemiti nezvirimwa, asi zvino dzava makomba nejecha chete. "One can observe large bare spots near Mazowe river. Those lands used to have crops and trees, but today they are just sand pits."

Analytically, one can observe that land degradation is viewed as an externality of mining activities. For miners to mine, they cut down all the trees and strip away all the land to extract the ore from under the land. However, due to lack of ownership and incentive for rehabilitation, they leave the mined land to degrade after mining. This leads to losses for both miners and neighbouring communities dependent on farming and forest production. This observation matches observations from literature concerning ASM in Sub-Saharan Africa, whereby the practice often causes deforestation and soil degradation. Similar trends were reported in studies by Hinton et al., (2023), and Mutemeri et al., (2021).

Looking at the issue from the Tragedy of the Commons approach described by Hardin, it is clear that the destruction and degradation of the environment in Bindura is consistent with this model of resource use. Since the land around the areas where mining occurs is considered a common pool resource where there are no restrictions on ownership or the obligation to rehabilitate the environment, the rational behaviour for miners would be to extract resources and mine without considering the consequences.

4.3.2. Water Pollution and Siltation

Artisanal mining activities in Bindura District have resulted in water pollution and river and stream siltation, particularly in the Mazowe River basin. Mercury contamination during gold mining, direct discharge of waste material from mining, and soil erosion resulting from open pits were identified as the major causes. Some respondents had noticed changes in water colour and quality, decreased fish populations, and health problems associated with the use of water in areas where gold is mined. One gold miner said,

"Mushe uremesa, inosuka izvo rwizi. Mvura inosviba uye zvinhu nguva inonhuwirira zvinhu zvakawanda nekuimba kwemekiyuri." "After panning, we wash the soil in the river. The water becomes muddy and sometimes smells of the mercury."

One participant stated:

"Rwizi ruimbowe ruakachena. Rino ruave rutsvuku kuzhinji, uye huva dzadzikira. Vana vashambara imomo vaihatwa nemapundu." "The river used to be clear. It's brown now most of the time, and the fish are scarce. Children who swim there develop rashes."

A second focus group member commented:

"Tinoona ivhu rakawanda rematope pamahombekombe erweizi. Kanaka chinaya, ivhu resi rasununguka riri mumakomba rinokukurwa riciedza mumvura." "We see much silt deposited in the river banks. Whenever it rains, all the loose earth in the pits flows straight into the river."

The interpretation of these stories reflects that water resources are viewed as disposal facilities rather than being considered a commons. Miners focus more on the immediate extraction of gold and utilization of land, whereas the cost of water pollution and siltation is borne by the broader community that relies on these waters for domestic and farming purposes. Without any control systems in place, pollution builds up over time, and eventually affects water quality for everyone using it. This is consistent with previous research conducted in Zimbabwe on the impact of ASM. Mercury contamination and siltation of rivers in Zimbabwe due to artisanal mining practices were reported by Nyamukondiwa et al. (2020). Furthermore, Hinton et al. (2023) report that water pollution is one of the most frequent environmental impacts caused by small-scale mining operations.

In this case, the Tragedy of the Commons concept by Hardin can be applied since the water pollution and siltation that characterize Bindura exemplify the degradation of common water resources in an open-access situation. Since water resources are shared without private property rights or controlled discharge, it is evident that the actions taken individually, such as discharging wastewater and erosion, lead to the degradation of water resources due to the collective harm of the actions aimed at benefiting individuals.

4.3.3. Health Risks from Chemical Use

The participants pointed out that the use of mercury in gold extraction and refining is hazardous not only to the workers themselves but to all residents of the area. Exposure to mercury can take various forms, including inhalation when burning it with gold, as well as skin contact and contamination of water. The symptoms described by respondents included such as headache, skin problems, breathing issues, and concerns about the possible accumulation of mercury in nature and food sources. For example, one of the gold miners mentioned that,

Patinopisa mekiyuri negoridhe, utsi hunopararira kwese. Dzimwe nguva unonzwa dzungu nechifuva chichipisa, asi isu hatina masiki. "When we burn the mercury with gold, the smoke goes everywhere. Sometimes you feel dizzy and your chest burns, but we have no masks".

In one of the discussions, one participant said,

Maoko angu anobuda maronda nekubata mekiyuri. Tinoziva kuti zvine njodzi, asi hapana imwe nzira yatinoziva yekuburitsa goridhe. "My hands get sores from touching the mercury. We know it is dangerous, but there is no other way we know to get the gold out".

The key informant continued,

Tinoona nyaya dziri kukiriniki dzevacheri vane matambudziko eganda nekutadza kufema. Tsvina yacho inorerera ichienda murwizi futi, saka vanhu vari pasi perwizi vanobatwawo. "We see cases at the clinic of miners with skin problems and difficulty breathing. Waste is disposed of in the river as well, so people living downstream are affected as well".

Interpreting these statements, it is clear that the health dangers are considered part of the extraction process since there are no other options, training, or protective equipment available. The miners themselves prefer short-term health risks to long-term gold collection, with the consequences extending beyond the individual miner to their entire families and community who share the same water and air. With no regulation or ability to use safer practices, exposure will continue unabatedly. This is consistent with previous studies done on the subject in Zimbabwe and Sub-Saharan Africa. Nyamukondiwa et al. (2020) and Hinton et al. (2023) both highlight the prevalence of mercury exposure and the health dangers it entails within artisanal mining camps.

From the lens of the Tragedy of the Commons by Hardin, the health risks posed by chemicals are a clear demonstration of the dangers associated with unrestricted access to the same environmental space. This is because the air, water and soil act as common spaces with no regulation for the disposal of any chemical, hence when a miner uses mercury in their work, it creates an externality for the larger group.

4.4. Socio-economic Effects on Livelihoods

4.4.1. Income and Employment

The artisanal mining was cited as one of the easiest and readily available means of earning a living or engaging in employment in Bindura District. The activity is seen as providing daily or weekly earnings to enable families meet basic necessities like food, school and health costs. To some miners, it is their main form of occupation whereas to other, it acts as a fall-back means of income earning if other options, such as agriculture are not available. An artisanal miner was quoted saying,

Kuchera ndiko kunoisa chikafu patafura yemhuri yangu. Pasina izvi, handizive kuti tingaitei. "Mining is what puts food on the table for my family. Without it, I don't know what we would do".

A focus group discussion participant said,

Kana mvura ikatadza kunaya, vanhu vanouya kurwizi kundochera. Kunyangwe iri mari shoma, inokubatsira kuti urambe uchifamba. "When the rains fail, people come to the river to dig. Even if it is little money, it keeps you going".

A key informant further revealed,

"Many young men have been forced to leave schools for employment in the rivers because they cannot get formal jobs. 'Although it's not formal, you earn money fast as compared to farming.'"

In terms of analysis, the statements imply that mining is an adaptable source of income where people can use their labour where there are no jobs. The earnings are not regular since they will be determined by the availability of minerals, climate and market prices. Nevertheless, it is better than farming since they are immediate while agricultural profits are slow, especially in Zimbabwe.

Mining provides indirect employment for people in the transportation sector, food vending, and suppliers of equipment used in mining.

According to the results from Bindura, artisanal mining is indeed an easily accessible buffer source of livelihood through which young people and their families can get money to fall back on in times of crop failures. This is consistent with research done in areas like Shurugwi, Kadoma-Chakari, and Matabeleland South where ASM has been found to create employment indirectly through labour absorption.

4.4.2. Negative Social Impacts

In addition to income and employment issues, negative social impacts related to artisanal mining were cited by the participants of Bindura District. The social problems included substance abuse, increased dropout rates from schools, family quarrels and insecurity in the areas near the mines. As a result of earning money through artisanal mining, there have been alterations in family and community life, especially for youths. A mine owner remarked,

Vamwe vechidiki vanowana mari nhasi voipedzera doro nekubhejera. Mangwana acho vanenge vadzoka kuchera zvakare. "Some young men get money today and spend it all on beer and gambling. The next day they are back digging".

A participant from one of the focus groups said,

Vana vanosiya chikoro vachitevera vabereki vavo kurwizi. Vanoti chikoro chinononoka, asi kuchera kunopa mari izvozvi. "Children leave school to follow their parents to the river. They say school is slow, but mining gives money now".

Another key informant noted that, "Kune kurwisana kwakawanda nekubirwa munzvimbo dziri pedyo nekuchera. Vanhu havachavimbana nekuti munhu wese ari kuedza kuchengetedza nzvimbo yake yekuchera."

This means,

"There are more fights and theft cases in the areas of mining. People cannot trust each other because they are all trying to protect their claims."

Interpreting this statement, we see that the social consequences brought about by mining are quite numerous and affect the communities in Bindura. While people get some money through mining which enables them to spend freely and earn income, the informal nature of this process also brings social costs on them. People do not have the rules of earning a living in place and hence spend money recklessly and invest little in educating their children.

The focus group statement about children leaving school to join their parents in going to the river corroborates findings from rural Zimbabwe concerning ASM competing with school enrollment. According to Mkodzongi and Spiegel (2019), although mining earnings may be used to pay school fees, it also leads to the attraction of mining at the expense of education because of the desire for instant gratification, particularly amid agricultural shocks. Chigwida (2023)'s case study of Shurugwi is another example of the impact of ASM on education among youth.

4.4.3. Conflicts over Resources

Competition concerning mining sites, mineral rights, water rights and land rights was cited as a cause of conflict in the Bindura District. Conflicts are caused by individuals, groups, or organizations competing against one another in order to mine minerals. Without formal claims being made or clearly marked boundary lines, conflict occurs and is normally settled via negotiations, coercion, or simply withdrawing from the site.

One participant commented,

Vanhu vanorwa pamusoro pemakomba. Ukasiya gomba rako zuva rimwe chete, mumwe munhu anoritora. "People fight over pits. If you leave your hole for one day, someone else will take it"

Another participant said,

Varimi vanonyunyuta kuti tinoparadza minda yavo uye tinoshandisa mvura yavo. Isu tinopokana nekuti isuwo tinoda kurarama. "Farmers complain that we destroy their fields and use their water. We argue because we also need to survive"

According to another key informant,

"Dzimwe nguva mapoka ane vanhu vazhinji kana mari yakawanda anosundidzira vacheri vadiki kunze kwenzvimbo dzakanaka. Izvi zvinokonzera kukakavara kukuru. "

From an interpretive perspective, this shows that the combination of resource scarcity and the existence of open-access systems results in zero-sum competition among individuals. Because there are no established systems or mechanisms for the establishment of individual or group property claims or conflict resolution, defence is made through numbers. Conflicts also have impacts in terms of affecting relations between miners and farmer communities, thus affecting social cohesion in areas where survival depends on the same resources. The resource conflicts highlighted in Bindura District illustrate the essential issues associated with the tragedy of the commons according to Hardin. Mining locations, water sources, and arable land become open-access systems of resource utilization due to the absence of property rights and effective regulations. In such circumstances, it is logical for each mining group to act accordingly by maximizing their benefits through access to these resources before other groups take them up.

In the end, this attempt at individual self-benefit will yield results that affect all parties involved negatively. Conflicts about ownership of pits, damages to farmlands, and fights for scarce water emerge, and they are solved using either violence or exclusivity from use of such natural resources. The lack of clear definition of ownership makes it impossible for people to conserve these resources. They, therefore, compete and turn them into sources of social conflict as well as making it difficult for other people to access them. The conflicts about resources in Bindura are therefore clear examples of how common-pool resources without regulation are abused and turned into areas of competition.

The situation in Bindura is an example of how the general trend seen in both Zimbabwe and Ghana is true. This is because of weak property rights and lack of regulation makes the areas of ASM prone to takeovers, violence, and conflict between miners and farmers about resources. This happens just as shown in Matabeleland South and Mzingwane district by Moyo (2024).

4.5. Opportunities for Sustainable Practices and Mitigation Strategies

4.5.1. Formalization and Training

From the interviews conducted, it appeared that the negative effects associated with artisanal mining could be lessened through proper formalization and adequate training of the miners in order for this sector to continue serving as an economic activity in the Bindura District. The artisanal

miners expressed their readiness to register and operate within set procedures if this could be done affordably and easily. Furthermore, the interviewees felt that the need for training on better techniques of extracting and processing the gold would solve both health-related and environmental concerns.

One artisanal miner said,

Dai zvisina kudhura uye zvisina kuoma, taizonyoresa. Panguva ino hatizive kuti zvoitwa sei. “If it is not expensive and complicated, we would register. Right now we don’t know how”.

Another person from the focus group discussed said,

Tinoshandisa mercury nekuti ndizvo zvatakadzidziswa. Kana mumwe munhu akatiratidza imwe nzira inoshanda, taizoedza. “We use mercury because that is what we were taught. If someone shows us another way that works, we would try it”.

One of the informants said,

Kudzidziswa nezvekuchengeteka nekudzoreredza ivhu kwaizobatsira. Vanhu havazive kuti makomba anogona kuzadzwa zvakare kana kuti mercury inogona kutorwa. “Training on safety and land rehabilitation would help. People do not know that pits can be refilled or that mercury can be captured”.

These comments, thus, imply that dangerous practices are followed not due to any negligence, but simply due to ignorance regarding formal procedures and lack of technical knowledge. Formalization, as such, would enable the miners to make a claim through their association, get services and even get accountable. Training, on the other hand, would offer practical ways to the miners to protect their environment and themselves without missing their incomes. The interest shown by the miners implies that intervention is possible provided certain obstacles are addressed.

Formalization and training help to overcome the central issue of the Tragedy of the Commons by moving artisanal mining activities in Bindura from open access, which makes the use of the commons an unregulated process, to regulated resource use. In the open access situation, each person uses the commons to their advantage, since there is no possibility to exclude someone else from using it, and thus the individual has neither incentive nor control over future exploitation.

This results in over-exploitation, degradation of natural resources and associated negative outcomes as analyzed above. Formalization implies creation of certain rights and obligations over specific plots, which provides miners with the incentive to protect and restore, rather than abandon, degraded plots. Training is needed as a complementing step to reduce information asymmetries and ensure miners have safe and effective techniques without resorting to harmful practices such as the use of open mercury.

With formalization and training, the underlying incentives causing the Tragedy of the Commons problem are transformed so that individual actions do not result in collectively destructive behaviour. Studies suggesting that the implementation of formalization and training mitigates ASM risks in cases where barriers have been overcome are Pact's ZAAMP (2019) in Zimbabwe, which has established that 70 percent of artisanal miners lack skills, and training on safety measures, mercury reduction and relevant legislations helped mitigate ASM risks at a pilot site in Gwanda, Kwekwe, and Shurugwi. Another study that suggests that formalization is the basis of mitigating risks in the ASM industry is that by Moyo (2018), on the impact of ASM on the environment in Zimbabwe.

4.5.2. Alternative Livelihoods

It was observed that increasing access to alternative livelihood options would help alleviate some of the pressure from artisanal mining on natural resource bases in Bindura district. It was found that many of the miners considered leaving mining as an option if they had other means through which they can earn money and receive training. The common alternatives that were mentioned include agriculture, trading, and vocational trades but lack of resources and markets were some of the challenges associated with them. In reference to a quote given by one of the miners,

"Ndaiwana mari yekutanga bindu kana chitoro, ndaizosiya rwizi. Kuchera kunorema uye kune ngozi". "If I had money to start a garden or a shop, I would leave the river. Mining is hard and dangerous"

One participant during a focus group discussion stated,

"Tinoziva kuti kurima kwakachengeteka, asi zvekushandisa pakurima zvinodhura uye mvura yekunaya haisisina kuvimbika". "We know farming is safer, but the inputs are expensive and the rains are not reliable anymore"

Tsvanoda vanoda dzidziswa muvanhu wehunyanzvi uye rubatsiro rwehuku rinomuna madi. Madi ino anekuda zvinowadziro pane hondo yenzira nekukasika. "Young people need training skills and small grants. At the moment mining is the only activity that earns money fast".

In terms of interpretation, this means that mining continues because the alternative livelihoods have financial and structural barriers but not preferences. Alternative livelihood activities would help minimize the numbers of people going into mining during shocks to agriculture. In order to do this, the alternative livelihoods must fit the environmental conditions, be affordable to resource-poor communities and have income streams similar to mining. Generally speaking, alternative livelihoods are one way of mitigating informal mining by ensuring that alternative sources of income are created, which would minimize pressure on the mineral commons.

Alternative livelihood options help tackle the Tragedy of the Commons since they decrease the number of users of the mineral and land commons within Bindura District. As an open access situation implies, each user benefits from taking as many resources from it as he/she can because he/she cannot limit other individuals' exploitation of the commons. As a result, the situation develops into a case of over-exploitation, destruction of forests, contamination of rivers with chemicals and disputes over mining places. Introducing different forms of activities which do not depend on these common areas provides the opportunity for people to reduce their exploitation and dependence on the commons. Providing miners with alternatives such as agriculture, trade, and other skilled labour which allow them earning enough money makes less people exploit the land. This results in decreasing the exploitation rate and improving the quality of the environment. Thus, alternative means of earning help eliminate the existing situation.

These results are in line with studies conducted in Mhondoro Ngezi and Shurugwi by Mkodzongi & Spiegel (2019) and Charehwa (2023), respectively, where it is shown that ASM and farming are related activities, but ASM miners do not change occupations unless there are other means of livelihood that can provide equal income. Like what happened in Matabeleland South and Mzingwane District, the current research shows that over-exploitation of the commons occurs due

to open access systems and weak institutions. Nevertheless, it is clear that unlike previous works, where license requirements and class relations were seen as the main barriers to exit from ASM, rainfall unreliability and high costs are the immediate problems in Bindura.

4.5.3. Role of Stakeholders

Multiple stakeholders were indicated as important for promoting safety and sustainability of artisanal mining in Bindura district. Some of the key stakeholders mentioned by the participants include the government, traditional leaders, NGOs, and mining associations. The respondents agreed that a successful intervention will require collaboration, clear communication and support beyond just punitive measures. The absence of regular contact between miners and authorities was seen as one of the reasons why miners do not follow any formal procedures. One of the miners commented,

"Vanhu veherumende vanongouya kana pava nedambudziko. Vanofanira kuuya kuzotidzisa kutanga. Government officers only come when there is a problem. They should come to teach us first".

A member of the focus group added,

"Madzishe anogona kubatsira kana akabatanidzwa. Vanhu vanovateerera munharaunda".

Another key informant noted,

Masangano eNGO akaedza kuunza ma retort nekudzidzisa, asi hazvisvike kune vose. Tinoda zvirongwa zvinoshanda padanhu resaiti. "The NGOs have tried to provide the retorts and trainings, but they do not seem to be reaching everyone. What we need are programs which will operate on the site."

Analytically, one can note from the above narratives that the role of stakeholders in this case can be seen as that of possible brokers who could assist with the formalization of mining activities, provision of trainings as well as linking the miners to markets. The government could help by providing the necessary legal framework and enforcing the laws, while the chiefs could play the role of mobilizing community members. On the other hand, NGOs can provide the much-needed

financial assistance and expertise. Acting alone, however, these stakeholders are unable to impact large segments of the population.

The involvement of stakeholders is directly related to the institutional void that causes the Tragedy of the Commons in Bindura's mining areas. An institutionally void resource situation is characterized by the lack of authority and incentives on the part of anyone to regulate the use of the resource, which means that individually optimal behaviour results in the degradation of the commons. Stakeholders introduce the necessary institutional mechanisms for the management and enforcement of usage norms and coordination of miners' activities. Governments may set up property rights, traditional leaders may impose norms and resolve conflicts arising between the miners, while other organizations can provide training and appropriate technology, thereby reducing the cost of following the regulations. As a result of such a joint effort, all parties involved become accountable and responsible, which makes it rational to engage in certain activities because everybody else does the same thing and there is a penalty for not doing so. In case of no coordination among stakeholders, the level of regulation will be rather low and everyone will behave rationally independently.

4.6. Discussion of Key Findings

The findings from the Bindura District reveal that artisanal mining is deeply entrenched in the local economy, acting as a survival strategy and causing environmental and social change. Regardless of the objective considered, a common theme is evident, which is the lack of governance and alternative avenues available to miners leads them to make rational decisions in the short term, which ultimately have negative impacts on land, water and society as a whole.

Mining in Bindura District takes place due to low barriers to entry, with accessibility being another key factor. Mining methods used here are manual in nature, require the use of mercury and take place along rivers and abandoned mine shafts. These activities and equipment are affordable and accessible to individuals. Participants in mining include youth, males and even females. However, mining is carried out mostly during the dry season, when conditions favour extraction activities. This phenomenon is consistent with what was found by Mutemeri et al. (2021) and Hinton et al. (2023) in the region, where ASM provides employment opportunities in cases where formal

avenues of income generation are scarce. Mining for gold and the use of simple tools is consistent with findings from Nyamukondiwa et al. (2020).

Ecologically speaking, the effects are long-term and observable. Deforestation, land degradation, water pollution and mercury poisoning can be viewed as externality problems since each individual miner does not have private ownership and responsibility towards the resource. The burden of health care and environmental damage falls on the larger community, leading to decreased agricultural yield and increased threats to public welfare. Such results have also been observed in Sub-Saharan Africa, where informal mining practices have caused soil erosion, reduction of cultivable land, and mercury pollution in water sources. This conforms to the theory put forward by Hardin, the Tragedy of the Commons.

From socio-economic perspectives, the mining sector ensures immediate income and employment opportunities amidst other limited possibilities. Nevertheless, the advantages are temporary and associated with adverse social impacts such as drug abuse, school absenteeism, family strife and disputes over resources. According to McQuilken and Hilson (2016), ASM is an important fall back for rural communities but causes social disturbance when not well governed especially concerning money matters and youth involvement. Disputes among panners about pits, water and land in Bindura are another example of heightened competition due to poor enforcement of property rights and inadequate dispute resolution frameworks, as highlighted by Spiegel (2012).

Opportunities for mitigation identified through the participants' discussion include formalization and training, alternate livelihoods, and stakeholder role coordination, which will help in solving these institutional problems. First, formalization helps in defining rights and incentives for conservation, which is illustrated by Hilson and McQuilken (2014) and shows that when there is legality of operations and provision of assistance, it results in compliance with environmental issues. The knowledge gap can be addressed by engaging in training, and according to Zimbabwean experiences in pilot projects, the retorting technology and training has shown the reduction in mercury usage. Secondly, alternate livelihoods decrease dependence on mineral commons, based on the information provided by Hilson and McQuilken (2014) that diversification decreases ASM pressures. Finally, stakeholder coordination provides the necessary structure and assistance to implement changes, which include traditional leaders and non-governmental organizations to assist in mediating and implementing interventions. It is concluded that the

problem faced by Bindura does not arise from a lack of skills but rather institutional challenges. Therefore, sustainable management requires moving the ASM outside the open access commons into a structured institution managing livelihood needs, environmental concerns, and community well-being.

4.7. Chapter Summary

This chapter presented findings on the nature, environmental impacts, socio-economic effects and mitigation strategies for artisanal mining in Bindura District. The data show that ASM is deeply embedded in local livelihoods but is largely unregulated and environmentally damaging. Chapter Five will summarize these findings, draw conclusions, and provide recommendations for policy and practice.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0. Introduction

This chapter presents the summary of the study, draws conclusions based on the findings in Chapter Four, and provides recommendations for policy, practice, and future research. The study examined the impact of artisanal mining on the environment and livelihoods in Bindura District, guided by four objectives: to describe the nature, scale and distribution of mining, to assess environmental consequences, to examine socio-economic effects and to identify opportunities for sustainable practices and mitigation strategies.

5.1. Summary of Key Findings

The study of artisanal mining in Bindura District examined four objectives, and the findings reveal a clear link between how mining is organized, its environmental and social costs, and the conditions needed for more sustainable practices.

Concerning the type, size and distribution of mining activities, the study found that mining in Bindura is done manually and minimally mechanized, with heavy reliance by miners on mercury in the recovery process. Mining is unevenly distributed and mainly occurs at selected hot spots like near Mazowe River or where old mines have existed. Mining activity depends on the season, with a higher occurrence during the dry season, when river levels are reduced, and farm activities are scarce. For most people, including youths, mining provides their primary source of livelihood since they cannot access any other form of employment.

Environmental impacts resulting from mining include degradation of forests and lands near mining areas and siltation and chemical pollution of rivers in which they mine. Mercury used in mining poses a continuous threat to the well-being of miners and people in downstream areas due to its dangerous nature. Environmental damage continues because mining is carried out using open access rules, implying that no one is responsible for mining activities, so no rehabilitation can occur.

In terms of socio-economic effects, there is the same dichotomy. On one hand, mining activities provide instant income to support many families, and on the other hand, they create a sense of instability in the community. Among the socio-economic challenges associated with mining, the researchers found issues related to substance abuse, school dropout, family strife and fights over claim rights and access to water. These challenges are more evident in young miners, especially in areas with no regulations.

Lastly, on the issue of sustainability and mitigations options, respondents mentioned such initiatives as the formalization process, skill development, and livelihood diversification. The key requirement of success was removing barriers of cost, accessibility, and information, and the initiative should be conducted right within the mining community. Other stakeholders identified were government institutions, traditional leadership, NGOs, and mining associations. In general, all of the findings fit perfectly into the idea of tragedy of commons presented by Hardin. The unrestricted access triggers the strategy of survival that destroys the collective base for the society.

5.2. Conclusions

The conclusion from the study is that artisanal mining in Bindura remains informal, labour-intensive, and influenced by seasons and economic needs. This kind of practice acts as one of the most important components of the informal economy, acting as an absorbent for labour that cannot be absorbed by the formal sector. However, such importance and relevance are not controlled by any formal mechanism, thus leaving the practice open to possible exploitation.

From an environmental standpoint, due to the lack of regulation, the activity has had negative impacts in terms of damaging the land and the quality of water used in the process. Mercury is used during the recovery process and the consequences of its usage can be dangerous not only for the miners but for the whole community using the same sources of water and soil. Since there are no clear indications of who is responsible for the land degradation and rehabilitation, those negative impacts remain externalities.

The socio-economic dimension of mining ensures income which is important for the survival of families, especially those of children who are often denied entry into the formal labour force. Nevertheless, the income from such mining is not stable. The findings show some connections

between mining operations and drug abuse, high dropout rates, family quarrels, and resource conflicts. In regions characterized by weak regulatory capacity, there is high competition over claims to mining and water resources.

However, despite all the challenges, the study shows that sustainable transformation can be achieved provided that incentives are redesigned. Through the process of formalization, training in the use of safer processes of mining, development of alternative sources of income, and collaboration among different parties, it becomes possible for the interests of individuals and the community as a whole to coincide. This is an issue of institutions rather than one of techniques.

5.3. Recommendations

For Policy and Government:

1. Simplify and subsidize the formalization process for artisanal miners to improve access to legal claims and support services.

2. Integrate environmental rehabilitation requirements into mining permits and enforce them through decentralized monitoring involving traditional leaders.

For Practice and Implementation:

1. Scale up training programs on mercury-free processing and site rehabilitation, delivered at mining hotspots and in local languages.

2. Support alternative livelihood initiatives that match local conditions, such as small-scale agriculture, beekeeping, and vocational skills, with start-up grants and market linkages.

For Stakeholder Coordination:

1. Establish district-level multi-stakeholder platforms involving government, traditional leaders, NGOs, and miner associations to coordinate interventions and build trust.

2. Use traditional leaders to communicate regulations and mediate disputes, leveraging their legitimacy within communities.

5.4. Areas for Further Research

Further research must be done to investigate how effective the use of formalization models is over time within Zimbabwe's ASM sector. Comparisons made between districts can reveal the influence of geology, governance and market access on results. More research should also be conducted regarding the health implications of mercury exposure among miners, as well as alternative income streams.

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APPENDICES

APPENDIX A : LETTER OF SUPPORT FOR RESEARCH

SUSTAINABLE DEVELOPMENT DEPARTMENT

BINDURA, ZIMBABWE
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BINDURA UNIVERSITY OF SCIENCE EDUCATION

CHAIRPERSON'S OFFICE

Tuesday 24 March 2026

TO WHO IT MAY CONCERN

Dear Sir/Madam

RE: RESEARCH SUPPORT LETTER FOR SUSTAINABLE DEVELOPMENT STUDENT

I am writing on behalf of the Sustainable Development Department requesting your collaboration on the research of our fourth-year student, BESTOW MAMBWERERE REGISTRATION NUMBER B2215114B. The student is studying for a 4-year Bachelor of Science (Honours) Degree in Development Studies (HBSc.DG).

In the fourth year of study, students are required to do field research which require them to do their data collection for research purposes.

Kindly accord her the due cooperation she truly deserves.

Yours faithfully,

.....
DR. J. BOWORA (CHAIRPERSON)
SUSTAINABLE DEVELOPMENT DEPARTMENT

APPENDIX B: SEMI-STRUCTURED INTERVIEW GUIDE FOR ARTISANAL MINERS

Project Title: Assessing the Impact of Artisanal Mining on Environment and Livelihoods in Bindura District, Zimbabwe

Researcher: Bestow Mambwerere (B221514B), Bindura University of Science Education
Objective: To collect in-depth data on mining practices, environmental changes, socio-economic effects, and opinions on sustainable solutions.

Instructions: Explain the study, assure confidentiality, obtain verbal consent. Record with permission. Probe where needed.

Section A: Background Information (do not record names)

Item	Response
Age	
Sex	
How long have you been mining?	
Do you mine full-time or part-time?	
What other work do you do?	

Section B: Nature, Scale and Distribution (Objective 1)

1. What tools and equipment do you use for digging, crushing, and washing?
2. Which minerals do you look for most? Where do you usually mine (riverbanks, old mines, etc.)?
3. How many people in this area do you think are involved in artisanal mining? Are there more miners in certain months? Why?

Section C: Environmental Consequences (Objective 2)

4. Have you seen changes in the trees, soil, or land around your mining sites? Please describe.
5. What happens to the water in the river or streams after you pan or wash ore? Have you noticed changes in water colour, fish, or silt?
6. Do you use mercury or any chemicals? If yes, how do you use them and where do you put the waste?
7. Have you or other miners experienced health problems like rashes, dizziness, chest pain, or trouble breathing?

Section D: Socio-economic Effects on Livelihoods (Objective 3)

8. How does mining help you and your family meet daily needs (food, school fees, medicine, etc.)?
9. Have you seen any bad social effects from mining in your community – for example, drinking too much alcohol, children leaving school, family fights?
10. Have you had conflicts with other miners, farmers, or authorities over mining pits, land, or water? How are those conflicts solved?

Section E: Opportunities and Mitigation Strategies (Objective 4)

11. Would you be willing to register your mining activities if the process was cheap and simple? Why or why not?
12. What kind of training or support would help you mine more safely and cause less damage to the land and water?
13. If you had another way to earn a similar income (e.g., farming, small business, trade), would you leave mining? What would you need to make that change?

Section F: Any other comments

……
……
……

APPENDIX C: FOCUS GROUP DISCUSSION (FGD) GUIDE

Participants: 6–10 artisanal miners or community members per group (total 4 FGDs as in Chapter 4)

Duration: 60–90 minutes

Moderator: Researcher

Welcome and ground rules: Introduction, confidentiality, one person speaks at a time, respect different views.

Opening question:

"Tell us how artisanal mining started in this area and how it has changed over the years."

Key discussion prompts (aligned with research questions):

1. **Nature and scale:** Describe a normal day of mining, who does what, where, and with which tools. Are there differences between men and women?
2. **Environmental changes:** What changes have you seen in the forests, soil, rivers, and wild animals since mining became common? Give specific examples.
3. **Livelihoods and well-being:** How important is mining for survival here? What are the good things and the bad things that come with it?
4. **Conflicts and rules:** Who decides who can mine where? What happens when two people claim the same pit? Do traditional or government rules work?
5. **Solutions:** If you could design a better way to manage mining, what would it look like? What help do you need from government, chiefs, or NGOs?

Closing: Summarise main points, ask if anything was missed, thank participants.

APPENDIX D: KEY INFORMANT INTERVIEW GUIDE

Target informants:

- Environmental Management Agency (EMA) officials
- Zimbabwe National Water Authority (ZINWA) officers
- Bindura District development officer
- Traditional leaders (chiefs/headmen)
- NGO project officers working on mining or environment

Questions:

1. What is your official role regarding artisanal mining regulation, monitoring, or support in Bindura District?
2. From your perspective, what is the scale and distribution of artisanal mining in the district? Which are the main hotspot areas?
3. What are the most serious environmental impacts you have observed (land degradation, water pollution, mercury contamination, etc.)? Do you have any monitoring data or reports?
4. How does artisanal mining affect local livelihoods positively and negatively? Do you have records of social conflicts, school dropouts, or health clinic cases linked to mining?
5. What current policies, laws, or programs address artisanal mining? How effective are they?
6. What are the main barriers to formalising artisanal mining or introducing sustainable practices (e.g., mercury-free processing, land rehabilitation)?
7. What recommendations do you have for balancing economic benefits with environmental protection and community well-being?

APPENDIX E: NON-PARTICIPANT OBSERVATION CHECKLIST

Site name: …….

Date: …… **Time:** ……

Weather: …….

Observation item	Description / Notes
Type of site (riverbank, abandoned mine, forest, farmland)	
Estimated number of miners present	
Tools and equipment observed (picks, shovels, pans, mercury, retorts, generators, pumps)	
Vegetation cover / deforestation (stumps, cleared areas, burning)	
Evidence of soil erosion or land degradation (pits, gullies, loose tailings, exposed subsoil)	
Water source condition (colour, turbidity, sedimentation, smell, floating waste)	
Signs of mercury or chemical use (containers, burning spots, waste dumping)	
Gender and age composition of miners (rough estimate: men, women, youth)	
Proximity to residential areas, farms, or water wells (distance in metres)	
Any safety or protective gear (boots, gloves, masks)	
Signs of conflict or cooperation among miners (e.g., arguments, shared tools)	
Evidence of rehabilitation (refilled pits, planted trees, fenced-off areas)	

APPENDIX F: INFORMED CONSENT FORM

Title of Study: Assessing the Impact of Artisanal Mining on Environment and Livelihoods in Bindura District, Zimbabwe

Researcher: Bestow Mambwerere (B221514B)

Institution: Bindura University of Science Education (BUSE)

Purpose:

To understand how artisanal mining affects the environment and people's lives in Bindura District, and to find ways to make mining safer and more sustainable.

Procedures:

You are asked to take part in either an interview or a focus group discussion. The session will last 45–90 minutes. With your permission, I will audio-record the conversation so that I do not miss any details. Your name will not be used in any report; all information will be kept confidential.

Risks and Benefits:

There are no physical risks. You may feel uncomfortable discussing some topics – you do not have to answer any question. There is no direct payment for participation, but your views will help inform policy and community programmes.

Voluntary Participation:

You decide freely whether to take part. You can stop at any time without giving a reason and without any penalty.

Contact:

If you have questions, you can contact the researcher (Bestow Mambwerere) or the Department of Development Studies, BUSE.

Consent Statement:

I have read (or had read to me) the above information. I understand the study and voluntarily agree to participate.

Participant signature (or verbal consent recorded): …… **Date:** ……

APPENDIX G: MAP OF BINDURA DISTRICT, ZIMBABWE

Description:

Figure F1 shows the location of Bindura District in Mashonaland Central Province, Zimbabwe. Bindura District lies approximately 88 km northeast of Harare. It is bounded by Mazowe District to the west, Shamva District to the east, and Guruve District to the north. The district spans roughly from 16.95°S to 17.65°S and 31.05°E to 31.65°E.

The map indicates:

- The main urban centre: **Bindura town**
- Major rivers: **Mazowe River** and **Bindura River**
- Artisanal mining hotspots identified in the study:
    - Mazowe River banks
    - Trojan Mine area
    - Shamva Road belt
    - Ran Mine periphery