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DEPARTMENT OF DEVELOPMENT STUDIES

ASSESSING THE ENVIRONMENTAL, SOCIAL AND ECONOMIC IMPACTS OF ARTISANAL MINING IN BINDURA DISTRICT

BY

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APPROVAL FORM

The undersigned certify that they have supervised the student, Yvonne Takaendesa. An assessment of the impacts of artisanal mining in Bindura District submitted in partial fulfilment of the requirements of Bachelor of Science Honours Degree in Development Studies at Bindura University of Science Education.

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DECLARATION

I, Yvonne Takaendesa, declare this project entitled, “Assessing the environmental, social and economic impacts of artisanal mining in Bindura District” is my own original work and has not been submitted to any other institution for the award of a degree or any other qualification. All sources of information used in this study have been duly acknowledged through references.

Signature……

Date……

DEDICATION

This project is dedicated to my sister, my constant source of strength during the hardest seasons of this journey. When the weight of this work felt overwhelming, she stood by my side. Her belief in me and constant motivation gave me the resilience to persevere. This achievement is as much hers as it is mine.

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ABSTRACT

This study assessed the environmental, social and economic impacts of artisanal mining in Bindura District. The research was motivated by the rapid growth of artisanal mining activities and their influence on local communities and the environment. The main objective of the study was to examine both the positive and negative effects of artisanal mining on, social wellbeing and environmental sustainability in the district. A mixed research was adopted, incorporating both qualitative and quantitative methods. Data were collected through interviews, questionnaires, document analysis involving artisanal miners and community members. The study found that artisanal mining contributes significantly to household incomes, employment creation and poverty reduction within local communities. However, the research also revealed several negative impacts such as land degradation, deforestation, water pollution, unsafe working conditions and increased social conflicts. The study recommended stronger environmental regulations, formalisation of artisanal activities, improved safety measures and community awareness programmes to minimise negative impacts while enhancing the economic benefits of the sector.

LIST OF FIGURES

Figure 2.1: Sustainable Development Pillars..... **Error! Bookmark not defined.**
Figure 3.1: Study area Map..... **Error! Bookmark not defined.**
Figure 4.1: Participants' involvement in artisanal mining related activities **Error! Bookmark not defined.**
Figure 4.2: Perceived impacts of artisanal mining..... **Error! Bookmark not defined.**
Figure 4.3: Effectiveness of regulatory frameworks for reducing negative effects of artisanal mining ..... **Error! Bookmark not defined.**

LIST OF TABLES

Table 4.1: Demographic Attributes of Participants ..... **Error! Bookmark not defined.**

Table 4.3: Perceived socioeconomic impacts of artisanal mining in Bindura..... **Error! Bookmark not defined.**

TABLE OF CONTENTS

APPROVAL FORM i
RELEASE FORM ii
DECLARATION iii
DEDICATION iv
ACKNOWLEDGEMENTS v
ABSTRACT vi
PLAIGERISM REPORT ..... **Error! Bookmark not defined.**
LIST OF FIGURES vii
LIST OF TABLES viii
LIST OF ACRONYMS xii
CHAPTER 1: INTRODUCTION 1
1.1 Introduction 1
1.2 Background of the Study 1
1.3 Problem Statement 3
1.4 Aim of the Study 4
1.5 Research Objectives 4
1.6 Research Questions 4
1.7 Significance of the Study 5
1.8 Delimitations of the Study 5
1.9 Definition of Key Terms 6
1.9.1 Artisanal and Small-Scale Mining (ASM) 6
1.9.2 Environmental Degradation 6
1.9.3 Livelihoods 6
1.10 Chapter Summary 7
CHAPTER 2: LITERATURE REVIEW 8
2.1 Introduction 8
2.2 Theoretical Framework 8
2.2.1 Sustainable Development Theory 8
2.3 Community Participation in Artisanal Mining 9
2.4 Socio-Economic Impacts of Artisanal Mining 10
2.5 Environmental Impacts of Artisanal Mining 12
2.5.1 Soil Degradation and Erosion 12
2.5.2 Water Resource Depletion and Contamination 12

2.5.3 Biodiversity Loss 13
2.5.4 Air Quality Deterioration 13
2.6 Regulatory Frameworks and Governance Challenges 14
2.7 Chapter Summary 15
CHAPTER 3: RESEARCH METHODOLOGY 16
3.1 Introduction 16
3.2 Description of the Study Area 16
3.3 Research Philosophy 17
3.4 Research Design 18
3.5 Research Approach 18
3.6 Target Population 18
3.7 Sample Size and Composition 18
3.8 Sampling Methods 19
3.8.1 Purposive Sampling 19
3.8.2 Convenience Sampling for Survey Component 19
3.9 Data Collection Methods 19
3.9.1 Structured Questionnaires 19
3.9.2 Key Informant Interviews 20
3.9.3 Field Observations 20
3.10 Data Analysis 20
3.11 Ethical Considerations 20
3.11.1 Informed Consent 21
3.11.2 Confidentiality and Anonymity 21
3.12 Chapter Summary 21
CHAPTER 4: DATA ANALYSIS, PRESENTATION AND DISCUSSION 22
4.1 Introduction 22
4.2 Demographic Profile of Participants 22
4.2.1 Gender Distribution 23
4.2.2 Age Distribution 23
4.2.3 Educational Attainment 23
4.2.4 Primary Income Source 24
4.3 Household Participation in Artisanal Mining 24
4.4 Perceived Socio-Economic Impacts of Artisanal Mining 26
4.5 Perceived Environmental Impacts of Artisanal Mining 28
4.6 Effectiveness of Regulatory Frameworks 29
4.7 Chapter Summary 31

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 32
5.1 Introduction 32
5.2 Summary of Key Findings 32
5.3 Conclusions 33
5.4 Recommendations 34
5.4.1 Policy Recommendation: Prioritise Formalisation Through Inclusive Registration .. 34
5.4.2 Community Practice: Establish Environmental Rehabilitation Committees 34
5.4.3 Mercury Reduction and Safer Processing 34
5.4.4 Social Support Interventions 35
5.4.5 Future Research 35
5.5 Concluding Remarks 35
REFERENCES 36
APPENDIX 1: QUESTIONNAIRE FOR ASSESSING THE IMPACTS OF ARTISANAL MINING IN BINDURA DISTRICT 42

LIST OF ACRONYMS

ASM	Artisanal and Small-Scale Mining
DRC	Democratic Republic of the Congo
FRGM	Fredda Rebbecca Gold Mine
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
IIED	International Institute for Environment and Development
ILO	International Labour Organization
LSM	Large-Scale Mining
SDGs	Sustainable Development Goals
SDT	Sustainable Development Theory
UNEP	United Nations Environment Programme
WHO	World Health Organization
ZJC	Zimbabwe Junior Certificate

CHAPTER 1: INTRODUCTION

1.1 Introduction

Zimbabwe sits on an extraordinary mineral wealth that spans gold, diamonds, platinum, chromium, and nickel, among numerous other commercially viable deposits. Within this mineralised landscape, Bindura District in Mashonaland Central Province occupies a particularly prominent position, with artisanal gold extraction concentrated across localities such as Kitsiyatota, Garati, and Makusha. The district has, over many decades, witnessed a steady expansion of small-scale and informal mining activity, making it a compelling site for examining the broader tensions between mineral resource exploitation and sustainable community development. This study interrogates the multi-dimensional consequences of artisanal mining on the environment, social fabric, and economic welfare of households in Bindura District.

Against a backdrop of chronic unemployment and constrained formal economic opportunities, many Zimbabwean households have turned to artisanal mining not merely as a secondary income stream but as a primary livelihood strategy. The allure of gold-bearing ground that can be accessed with rudimentary tools, without formal training or capital investment, has drawn men, women, and youth alike into the mining workforce. Yet this very informality, which lowers barriers to entry, also renders the sector inherently ungoverned and environmentally destructive. Understanding this paradox, where the same activity simultaneously sustains households and degrades the environments on which those households depend, is the central challenge this research addresses.

This opening chapter establishes the conceptual and contextual foundations of the study. It presents the background against which artisanal mining must be understood, identifies the specific problem the research confronts, articulates the objectives guiding the inquiry, and defines core terminology. The chapter also outlines the study's scope, significance, and delimitations so that readers are oriented to what the research does and does not claim to cover.

1.2 Background of the Study

On a global scale, artisanal and small-scale mining (ASM) represents far more than a marginal economic curiosity. Figures from the International Labour Organization indicate that the sector provides direct employment to upwards of forty million individuals, while the indirect beneficiaries, traders, processors, transporters, and household dependants, number well beyond one hundred and fifty million across more than eighty countries (ILO, 2021). These statistics

position ASM as one of the largest informal employment categories on the planet, rivalling many formal industries in terms of workforce size. In nations where formal economies have contracted or failed to absorb growing labour forces, artisanal mining frequently becomes the default employer of last resort.

Despite this economic significance, the defining characteristics of ASM, its reliance on manual labour, basic hand tools, limited or absent mechanisation, and operation outside formal legal and regulatory structures, create systemic vulnerabilities. Miners typically lack safety training, protective equipment, environmental awareness, and access to cleaner processing technologies. The consequence is a sector that, while generating income, simultaneously imposes environmental and health costs that are borne not only by individual miners but by entire surrounding communities and, in some cases, by national ecosystems (Alemu, 2018; Abebil et al., 2023).

The environmental footprint of unregulated artisanal mining is well documented in the international literature. Across multiple continents, researchers have catalogued how informal extraction strips protective vegetation, destabilises hillslopes, contaminates watercourses, and fragments natural habitats. Research conducted in the Amazon Basin linked small-scale gold mining to a measurable share of regional deforestation, with cascading effects on biodiversity and carbon sequestration (Alvarez-Berrios et al., 2021). The United Nations Environment Programme has drawn attention to mercury pollution as a particularly acute global concern, noting that gold processing by artisanal miners releases approximately one thousand metric tonnes of this neurotoxin into the environment annually (UNEP, 2022). These figures underscore that ASM's environmental consequences extend far beyond the immediate mine site.

Socially, the picture is equally complex. On one hand, artisanal mining income has been shown to fund household consumption, children's schooling, and asset accumulation in contexts where no comparable earning opportunities exist. On the other hand, the concentration of miners in particular localities brings crowding, crime, social conflict, gender exploitation, and the spread of communicable diseases including HIV/AIDS (Hilson et al., 2021). Regulatory frameworks designed to govern the sector have generally struggled to keep pace with the scale and mobility of artisanal operations, leaving miners and communities in a persistent governance gap (Nursamsi et al., 2024).

In sub-Saharan Africa, artisanal mining has historically filled the employment vacuum left by shrinking agricultural sectors and limited industrial development, particularly in rural areas and secondary towns. Countries across West, Central, East, and Southern Africa host large artisanal mining populations, each shaped by distinct geological endowments, political economies, and regulatory traditions. In the Democratic Republic of Congo, Ethiopia, Ghana, Tanzania, and Zimbabwe, among others, ASM has become deeply embedded in local livelihood systems, generating income while also generating conflict, pollution, and governance challenges (Mimba et al., 2022; Moyo et al., 2022).

Zimbabwe's relationship with artisanal gold mining stretches back centuries, predating the colonial period when indigenous communities extracted metals using methods that were modest in their environmental impact relative to today's practices (Chipangura, 2019). The post-colonial period introduced new dynamics: land reform from the year 2000 onwards, combined with severe economic contraction, hyperinflation, and the collapse of formal manufacturing, drove unprecedented numbers of Zimbabweans into informal gold mining. Nationally, the term 'makorokoza', a colloquial designation for artisanal miners, entered common parlance as the sector became a defining feature of the informal economy. Today, ASM contributes a meaningful share of Zimbabwe's gold output while remaining largely outside the formal tax and regulatory net.

Within this national context, Bindura District presents a case of particular analytical interest. Gold-bearing geology, proximity to regional markets, and a population with limited formal employment options have combined to make artisanal mining a dominant livelihood activity. Yet the impacts of this activity, environmental, social, and economic, have not been systematically assessed for the period spanning 2023 to 2025. This study therefore responds to a genuine empirical gap, one with direct policy relevance for local authorities, environmental agencies, and communities in Bindura and comparable districts across Zimbabwe.

1.3 Problem Statement

Artisanal mining in Bindura District embodies a profound development paradox: it is simultaneously a critical livelihood mechanism for thousands of households and a generator of serious environmental degradation and social dislocation. This duality makes straightforward policy responses impossible. Simply outlawing or suppressing artisanal mining without providing viable economic alternatives would remove a primary source of subsistence for a significant proportion of the district's population, particularly its most vulnerable members.

Conversely, allowing the sector to expand without governance or environmental oversight accelerates land degradation, water contamination, and social instability.

What makes this situation especially pressing is the apparent ineffectiveness of existing regulatory frameworks. Anecdotal and limited empirical evidence suggests that neither enforcement-focused approaches, such as raids and prosecutions, nor developmental interventions, such as formalisation programmes, have meaningfully altered the environmental or social trajectory of artisanal mining in Bindura. The policy gap between regulatory intent and operational reality remains wide.

Meanwhile, the costs of inaction are tangible. Degraded farmland, silted rivers, open pit hazards, rising rates of school dropout, increased crime, and public health burdens linked to mercury exposure and poor sanitation in mining camps all represent real and escalating costs to the community. These costs are largely externalised from the mining activity itself, borne instead by households, local government, and the natural environment. A rigorous, multi-dimensional assessment of artisanal mining's impacts is therefore both analytically warranted and practically necessary. This study directly addresses that need.

1.4 Aim of the Study

The primary aim of this study is to conduct a comprehensive assessment of the social, economic, and environmental impacts of artisanal mining as experienced by households and communities in Bindura District, Zimbabwe, covering the period from 2023 to 2025.

1.5 Research Objectives

The study is guided by the following specific objectives:

i. To determine the nature and extent of household participation in artisanal mining activities across Bindura District.

ii. To examine community perceptions of the socio-economic impacts generated by artisanal mining in the district.

iii. To assess perceived environmental impacts attributable to artisanal mining operations in Bindura.

iv. To evaluate how effectively existing regulatory and governance frameworks have reduced the negative consequences of artisanal mining in the study area.

1.6 Research Questions

The study is framed around four core research questions:

i. To what extent do households in Bindura District participate in artisanal mining, and what forms does that participation take?

ii. What socio-economic impacts do community members perceive to be associated with artisanal mining in the district?

iii. What environmental impacts do residents and stakeholders attribute to artisanal mining operations in Bindura?

iv. How effectively are current regulatory frameworks mitigating the negative social and environmental impacts of artisanal mining in Bindura?

1.7 Significance of the Study

This study makes a contribution at the intersection of academic inquiry and practical policy relevance. From a scholarly perspective, it adds to the growing body of empirical literature on ASM impacts in sub-Saharan Africa by generating context-specific, primary data from a Zimbabwean district that has received insufficient research attention. The findings enrich comparative understanding of how artisanal mining operates in distinct local contexts and challenge or confirm generalisations drawn from studies conducted elsewhere.

From a policy and practice standpoint, the study's findings have direct utility for government ministries responsible for mining, environment, and rural development, for the Zimbabwe Environmental Management Agency (ZEMA), for local authorities in Bindura, and for non-governmental organisations working in the field of sustainable livelihoods. By mapping the actual impacts experienced by communities rather than relying on regulatory assumptions, this research equips decision-makers with evidence needed to design more effective, contextually appropriate governance responses.

1.8 Delimitations of the Study

The study is geographically delimited to artisanal mining sites within Bindura District, Mashonaland Central Province, Zimbabwe. It does not extend to other mining districts, nor does it examine spill-over effects from large-scale regulated mining operations such as Fredda Rebecca Gold Mine or RaneMines. Temporally, the study covers three years from 2023 to 2025, enabling a short-term longitudinal perspective while remaining practically manageable.

The study's thematic scope encompasses environmental impacts, including land degradation, water pollution, and habitat disturbance; social impacts, including public health, crime,

community cohesion, and gender dynamics; and economic impacts at the household level. Macro-economic considerations such as national tax revenue from ASM or Zimbabwe's aggregate gold output are outside the study's remit.

1.9 Definition of Key Terms

1.9.1 Artisanal and Small-Scale Mining (ASM)

Artisanal and Small-Scale Mining refers to mineral extraction and processing undertaken with minimal mechanisation, low capital intensity, and predominantly manual labour techniques. The World Bank describes ASM broadly as mining carried out by individuals, family groups, or small cooperatives who typically lack formal land title and operate with rudimentary technology, often outside formal legal structures, particularly in rural areas of developing countries (World Bank, 2020). The International Institute for Environment and Development further emphasises the heterogeneous character of ASM, which ranges from subsistence-level hand-washing of alluvial material to organised pit mining involving crushing mills and mercury amalgamation (Buxton, 2013). A distinguishing feature is the sector's informal or semi-legal status, which places most practitioners beyond the reach of mining legislation, labour law, and environmental regulation.

1.9.2 Environmental Degradation

Environmental degradation denotes the progressive deterioration of ecosystem function and natural resource quality resulting from human activities. In the context of mining research, this concept encompasses the physical disruption of land surfaces through excavation, the chemical contamination of soils and water through the discharge of toxic processing residues, the loss of vegetation cover through clearing and fuelwood extraction, and the reduction in biodiversity that follows habitat destruction and pollution. The United Nations defines environmental degradation as any process that diminishes the capacity of an ecosystem to support human well-being and biodiversity (United Nations, 1997). Applied to artisanal mining, degradation is typically both localised at the mine site and diffuse in its downstream effects on water catchments and surrounding agricultural land.

1.9.3 Livelihoods

A livelihood, in the sense employed throughout this study, refers to the full portfolio of capabilities, assets, and activities through which households generate adequate and sustainable well-being. The widely adopted Chambers and Conway (1991) framework defines a livelihood as sustainable when it can withstand and recover from external shocks and stresses, maintain

or build its resource base, and do so without undermining the natural environment on which future generations depend. Scoones (1998) operationalises this framework through the identification of five capital types, namely human, social, natural, physical, and financial capital, all of which interact to determine household resilience and prosperity. In the context of artisanal mining, a livelihood lens asks not simply whether mining generates income, but whether it builds or erodes the broader asset base on which households rely over time.

1.10 Chapter Summary

This chapter introduced the study's rationale, background, and conceptual framework. It identified the paradox that defines artisanal mining in Bindura District: an economic activity that sustains households while degrading the environmental and social conditions on which those households ultimately depend. The chapter articulated four research objectives and four corresponding research questions, outlined the study's significance for both scholarship and policy, defined its geographic and thematic boundaries, and clarified key terms. Chapter Two proceeds to review existing theoretical and empirical literature on ASM impacts.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter situates the study within existing scholarly discourse on artisanal and small-scale mining. It begins with the theoretical framework adopted for the study, then proceeds through empirical literature organised around the four key thematic areas: community participation in ASM, socio-economic impacts, environmental impacts, and regulatory governance. The review draws on international, African, and specifically Zimbabwean literature, mapping both areas of consensus and points of contestation that the current study's findings will later address.

2.2 Theoretical Framework

2.2.1 Sustainable Development Theory

This study is grounded in Sustainable Development Theory (SDT), which posits that genuine development must harmonise economic growth, social equity, and environmental stewardship rather than treating these as competing priorities (Hariram et al., 2023). Rooted in the influential Brundtland Commission definition of 1987, the theory holds that present generations must meet their developmental needs without compromising the capacity of future generations to meet theirs. This intergenerational dimension gives SDT particular relevance for resource extraction contexts, where the depletion of non-renewable assets today may foreclose development options tomorrow.

The theoretical architecture of SDT rests on three interdependent pillars, often depicted as a Venn diagram in which the intersection of environmental, social, and economic systems defines the zone of sustainability. The environmental pillar demands that natural capital, including mineral resources, soil, water, and biodiversity, be managed in ways that preserve ecological function. The economic pillar requires that growth be equitable, inclusive, and long-term in orientation rather than short-term and extractive. The social pillar insists that development processes respect human rights, promote well-being, and strengthen community cohesion (Purvis et al., 2019). As illustrated in Figure 2.1 below, authentic sustainability emerges only at the convergence of all three pillars.



[Figure 2.1: Pillars of Sustainable Development - Nogueira et al., 2023]

The applicability of SDT to this study is direct and analytically productive. Artisanal mining in Bindura generates income and employment that are economically valuable to households. At the same time, it imposes environmental costs through land and water degradation, and social costs through health hazards, crime, and educational disruption. SDT provides the conceptual vocabulary to hold these simultaneous realities in view and to ask whether the net effect of artisanal mining advances or undermines the district's long-term development trajectory. By evaluating ASM through each of the three pillars, the framework encourages a holistic assessment that goes beyond simplistic condemnation or uncritical celebration of the sector (Sachs, 2012). This is the analytical posture the study adopts throughout.

2.3 Community Participation in Artisanal Mining

Globally, the question of who participates in artisanal mining, and why, has attracted considerable scholarly attention. The consensus that emerges from comparative studies is that ASM participation is rarely a freely chosen vocation. Rather, it is typically a rational response to structural economic exclusion: the absence of formal employment, the failure of agriculture to provide adequate returns, and the lack of alternative income-generation pathways in rural and peri-urban areas (Hilson et al., 2021). The World Bank (2020) estimates that approximately forty million people worldwide engage directly in artisanal mining, while another hundred and fifty million derive indirect economic benefits from the sector across eighty-plus countries. These numbers reflect a global livelihood strategy of enormous proportions.

Participation is typically driven by what development economists describe as push and pull dynamics. Push factors, including crop failure, retrenchment from formal jobs, land pressure, climate variability, and domestic economic crises, reduce the attractiveness or viability of alternatives. Pull factors, chiefly the perception that gold mining offers rapid cash returns with low formal barriers to entry, attract particularly younger participants who see conventional career pathways as closed (Hilson et al., 2021). The net effect is a sector that serves as a default safety valve when mainstream economic systems fail to absorb labour.

In African contexts, the rural roots of ASM participation are especially pronounced. Research across West and Central Africa demonstrates that artisanal mining is frequently seasonal and household-level, integrated into broader livelihood portfolios rather than constituting the sole source of income (Bryceson & Geenen, 2020). In Ghana and Burkina Faso, for example, farmers have traditionally combined annual crop cycles with dry-season gold panning along riverbeds. This integration makes participation difficult to measure and complicates attempts to formalise or regulate the sector without disrupting agricultural livelihoods.

Zimbabwe's trajectory of ASM participation follows a distinctive national political economy. The fast-track land reform programme launched in 2000, combined with a decade of severe economic contraction and the collapse of formal manufacturing and services, created conditions in which artisanal mining expanded dramatically (Mawowa, 2020). The sector became notably more demographically diverse than historical norms: women entered in substantial numbers through panning, crushing, and trading roles, while educated graduates and retrenched professional workers turned to mining when formal career paths evaporated (Mkodzongi & Spiegel, 2020; Chikohora, 2021). Research in mineral-rich districts has consistently found that households with artisanal mining income report higher consumption levels than comparable households dependent solely on agriculture, though this premium is qualified by income irregularity, price volatility, and the physical and social risks mining entails (Tembo, 2022).

2.4 Socio-Economic Impacts of Artisanal Mining

The socio-economic consequences of artisanal mining resist simple characterisation as either positive or negative. A substantial body of research confirms that ASM income generates real improvements in household welfare indicators, particularly in contexts of widespread poverty and limited formal sector employment. Studies from Latin America and Southeast Asia document associations between artisanal mining income and improvements in housing quality,

children's school enrolment, food security, and household asset accumulation (Verbrugge & Geenen, 2020). In Zimbabwe, field research in areas including Shamva and Gwanda has documented how gold panning income has funded the replacement of traditional grass-thatched structures with brick housing, purchased productive assets including livestock and farm inputs, and enabled school fee payment for children (Spiegel, 2020). These are concrete, material improvements that matter to affected households.

However, the same body of literature consistently identifies social disruption as a companion to economic gains. The concentration of miners in particular localities draws in accompanying populations, including food vendors, sex workers, and informal traders, transforming social landscapes in ways that stress community infrastructure and norms. Migrant worker inflows can generate tension with established residents, competition for natural resources, and cultural change that long-term community members experience as destabilising. Research across West African mining regions documents how mineral booms generate 'resource curse' dynamics even at the micro-level, producing inter-community conflict over land access, fuelling corruption among local officials, and disrupting gender relations (Crawford & Botchwey, 2020).

Public health consequences represent a particularly serious socio-economic burden. Mercury, widely used by artisanal gold miners for amalgamation, is a potent neurotoxin that accumulates in the bodies of miners, their families, and communities through inhalation of vapour, skin contact, and consumption of contaminated water and fish. Chronic mercury exposure has been linked to neurological damage, kidney impairment, and developmental harm in children born to exposed mothers (Steckling et al., 2021). Beyond mercury, artisanal mining creates occupational health risks through tunnel collapse, exposure to silica dust that causes pneumoconiosis, and injuries from poorly maintained machinery. High rates of work-related injury and death impose financial strain on families and reduce the productive capacity of communities.

In Zimbabwe specifically, a well-documented social concern is the link between artisanal mining and organised criminal violence. Machete-wielding gangs locally termed 'mashurugwi' have been associated with turf battles over productive mining sites, generating a climate of insecurity that undermines investment, intimidates communities, and reflects a broader breakdown of rule of law in the informal mining sector (Ganda, 2022). This violence, combined with rising crime rates more broadly, school dropout among youth attracted by mining income, and the exploitation of women in low-paid and physically hazardous roles, illustrates how

economic gains from ASM can be offset by serious social costs that are poorly captured in income-focused analyses.

2.5 Environmental Impacts of Artisanal Mining

2.5.1 Soil Degradation and Erosion

Land disturbance represents the most immediate and visually evident environmental impact of artisanal mining. The extraction process involves stripping vegetation, excavating surface and sub-surface material, and stockpiling waste rock and tailings, all of which fundamentally alter the physical structure of soils. Once the protective vegetative layer is removed, exposed soils are vulnerable to accelerated erosion by both rainfall and wind, producing sediment loads that choke downstream watercourses and reduce the productivity of surrounding agricultural land (Alemu, 2018). Studies in Ethiopia's artisanal mining regions have quantified soil erosion rates at mining-affected sites that dramatically exceed both natural baseline rates and international thresholds for agricultural sustainability, with documented losses in certain opal mining areas reaching 13.2 tonnes per hectare annually (Getaneh & Shikur, 2022).

In Zimbabwe's artisanal mining zones, observers have documented extensive land scarring, gully formation, and the persistence of waste dumps that render previously productive agricultural land unusable for years after mining activity has ceased. The financial cost of rehabilitation, including re-contouring, topsoil replacement, and revegetation, typically exceeds the resources available to either individual mining communities or local government authorities, meaning that degraded land remains in a compromised state indefinitely (Hilson, 2016). This represents a transfer of environmental cost from mining activity to the broader community and to future generations who will inherit degraded land.

2.5.2 Water Resource Depletion and Contamination

Artisanal mining's relationship with water is one of mutual dependence and mutual harm. Gold processing requires substantial water volumes for washing, sluicing, and amalgamation, creating significant pressure on local water resources, particularly in seasonally arid environments where water scarcity already constrains agricultural and domestic needs (Abate & Sisay, 2024). Where artisanal mining concentrates along river corridors, stream channels are frequently diverted, deepened, or physically disrupted, altering natural flow regimes and sedimentation dynamics.

More alarming than water quantity concerns is the contamination of water quality through the discharge of toxic processing chemicals. Mercury, used to bind fine gold particles in

amalgamation, is released into waterways and soils where microbial processes convert elemental mercury to methylmercury, a form that bioaccumulates up aquatic food chains. Communities that rely on affected water bodies for drinking, fishing, and irrigation face chronic exposure to a substance that causes irreversible neurological damage even at low concentrations (Lemessa et al., 2022). Cyanide, used in some more capitalised ASM operations, poses additional acute risks. Research across African mining regions, from Ethiopia's Benishangul-Gumuz region to rivers in Ghana and Zimbabwe's own gold panning rivers, consistently documents elevated heavy metal concentrations in mine-adjacent water bodies (Haile et al., 2024; Chimdi & Degefu, 2019).

2.5.3 Biodiversity Loss

The conversion of natural land to mine sites, combined with the influx of human populations into previously remote areas, exerts severe pressure on biodiversity. Vegetation clearance removes habitat directly, while access roads cut into previously inaccessible areas enable subsequent land conversion by agriculturalists, loggers, and other resource users, multiplying the effective area of habitat loss beyond the mine footprint itself (Alvarez-Berrios & Aide, 2015). In ecologically fragile regions, including forested watersheds and biodiversity corridors, artisanal mining can be a primary driver of species loss, as documented in research from Amazonian and Central African contexts (Barenblitt et al., 2021).

Aquatic biodiversity is particularly vulnerable to mercury contamination. Fish, amphibians, and aquatic invertebrates exposed to methylmercury experience physiological impairment, reproductive failure, and population decline. Even after mining activity ceases, recovery of aquatic ecosystems can require decades, particularly in still-water systems where mercury settles into sediments and is remobilised seasonally (Esdaile & Chalker, 2018). The cumulative effect is an impoverishment of ecosystem services, including fisheries, water purification, and flood regulation, on which mining communities ironically depend for long-term food and livelihood security.

2.5.4 Air Quality Deterioration

Air pollution from artisanal mining operates through two primary pathways. The first involves the generation of particulate matter during drilling, blasting, crushing, grinding, and ore transport. Fine particulate matter, specifically particles below 2.5 micrometres in diameter, penetrates deep into the respiratory system and has been associated with elevated rates of silicosis, pneumonia, and cardiovascular disease in mining populations. Research conducted at

artisanal mining sites in Mongolia found particulate matter concentrations consistently many times higher than World Health Organization guideline levels (Gordy et al., 2022), and similar conditions have been observed in African mining communities.

The second and arguably more dangerous pathway is the atmospheric release of mercury vapour during the amalgam-burning stage of gold processing. When miners heat the gold-mercury amalgam to drive off the mercury and isolate gold, they release elemental mercury vapour in immediate proximity to their bodies and the bodies of others present, including family members working nearby. A global inventory conducted by Telmer and Veiga (2018) identified artisanal gold mining as the largest single source of anthropogenic mercury emissions globally, contributing roughly thirty-eight percent of total mercury released to the atmosphere each year. This atmospheric mercury deposits across regional and continental scales, but the most acute exposures occur among miners and their immediate communities.

2.6 Regulatory Frameworks and Governance Challenges

A consistent finding across ASM governance research is that formal regulatory frameworks have struggled to effectively govern artisanal mining. The reasons are multiple and interrelated. First, ASM populations are geographically dispersed, seasonally mobile, and often operating in remote areas beyond the practical reach of regulatory inspectors and environmental monitors. Second, enforcement agencies are typically under-resourced relative to the scale of activity they are mandated to oversee. Third, the economic desperation that drives participation in ASM means that enforcement-only approaches, even if physically feasible, tend to simply displace activity rather than eliminate it, generating community resistance and undermining local authorities' legitimacy (Ondayo et al., 2025).

In Zimbabwe, these structural challenges are compounded by legislation that critics argue is fundamentally ill-suited to the ASM context. The Mines and Minerals Act of 1961 was designed for a mining industry dominated by large-scale formal operators and has not been substantially updated to accommodate the realities of small-scale and informal mining (Matshona, 2024). The result is a regulatory vacuum in which most artisanal miners operate without registration, without environmental management plans, and without recourse to occupational health and safety protections. Alternative governance approaches, including formalisation programmes, community-based monitoring, and technology transfer to reduce mercury use, have been proposed and piloted in various African contexts, but their uptake and effectiveness in Zimbabwe remain limited (Hilson, 2016).

2.7 Chapter Summary

This chapter reviewed theoretical and empirical literature pertaining to artisanal mining's social, economic, and environmental dimensions. Sustainable Development Theory was adopted as the study's analytical framework, providing a multi-pillar lens through which to assess ASM's net development contribution. The empirical review confirmed that ASM generates genuinely dualistic outcomes: meaningful economic welfare improvements alongside serious environmental degradation and social disruption. Regulatory governance consistently emerges as a critical weak link. The following chapter outlines the methodological approach through which primary data were gathered to examine these dynamics in the specific context of Bindura District.

CHAPTER 3: RESEARCH METHODOLOGY

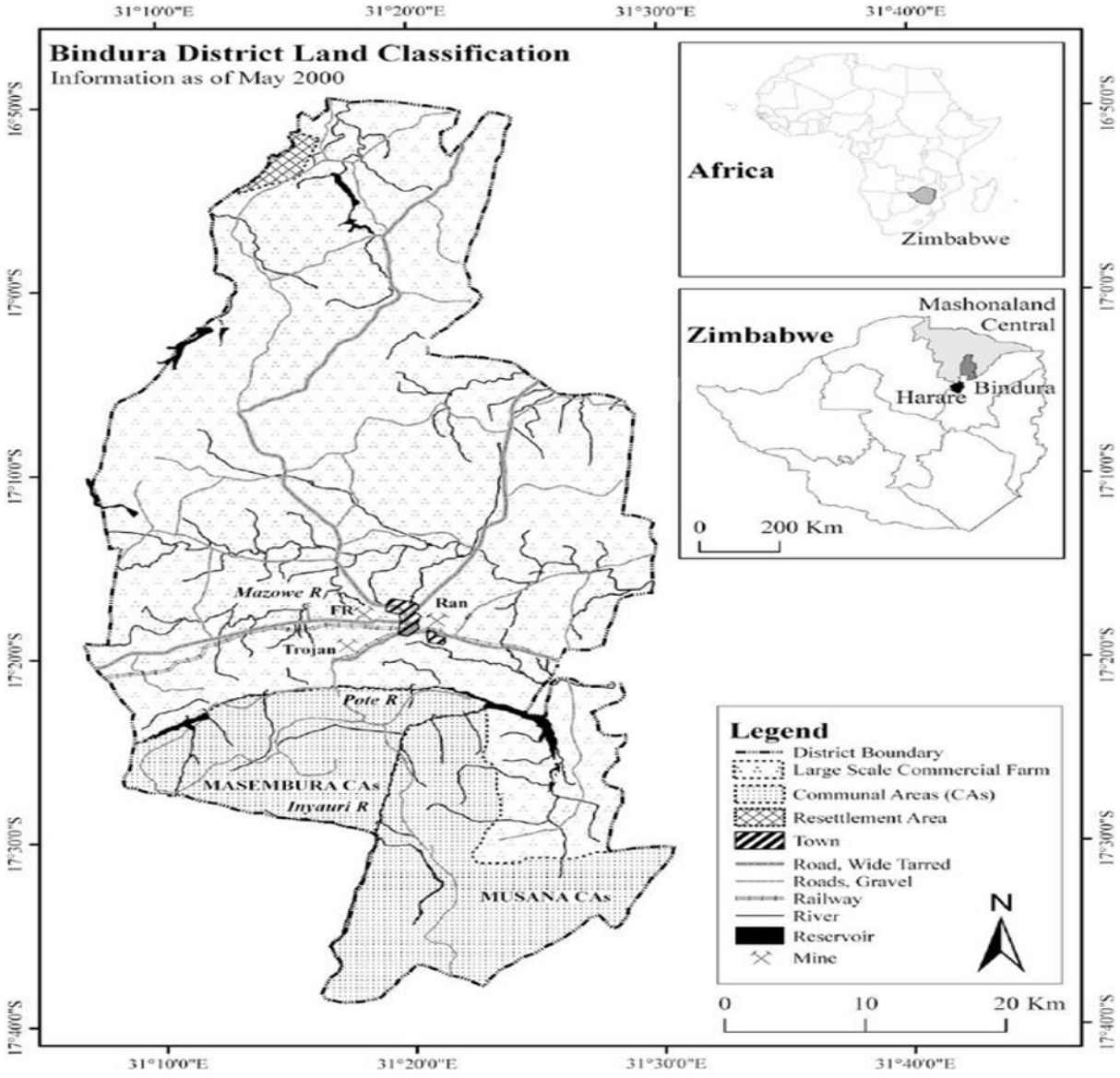
3.1 Introduction

This chapter describes the methodological framework through which the study's research objectives were addressed. It explains the research philosophy underpinning the inquiry, the design chosen to investigate ASM impacts, the approach taken to integrating different types of data, the population from which participants were drawn, the sampling procedures employed, and the methods used to collect and analyse data. It concludes with a discussion of the ethical principles that governed the research process. The methodological choices made throughout reflect the study's commitment to generating findings that are both empirically credible and practically actionable.

3.2 Description of the Study Area

Bindura District is the administrative hub of Mashonaland Central Province in Zimbabwe's north-central region. It shares boundaries with Mazowe, Mt Darwin, Shamva, and Domboshawa Districts and hosts a population engaged in a mix of urban commercial activity, smallholder agriculture, and informal mining. The district's geology is characterised by Archaean greenstone belts, which host significant concentrations of gold and, to a lesser extent, nickel, chromium, and platinum group elements. These geological formations have made the district historically significant in Zimbabwe's mineral economy and have attracted both formal large-scale operators and informal artisanal miners.

Major watercourses traversing the district include the Mazowe River and its tributaries, which serve both as water sources for domestic and agricultural use and as sites of alluvial gold panning. The climate is seasonally bimodal, with a summer rainy season from November to March supporting dryland agriculture, and a dry winter season during which artisanal mining activity typically intensifies as water levels fall and alluvial deposits become more accessible. The population is predominantly rural, with urban concentration in Bindura town, and subsistence farming remains important alongside mining and informal trade. Figure 3.1 presents a map of the study area.



[Figure 3.1: Bindura District Study Area Map]

3.3 Research Philosophy

The study adopts pragmatism as its guiding research philosophy. Pragmatism is particularly suited to applied social research problems that resist resolution through a single methodological tradition. Rather than committing to either a positivist position, which assumes that objective social facts can be measured and generalised, or an interpretivist position, which prioritises the subjective meanings participants attach to their experiences, pragmatism selects methods based on their fitness for purpose in addressing specific research questions (Creswell & Poth, 2018). For a study that must simultaneously quantify the scale of household participation in artisanal mining and understand the lived texture of how communities experience its impacts, a pragmatist philosophy provides the epistemological justification for mixing quantitative and qualitative methods.

3.4 Research Design

A case study design was adopted, treating Bindura District as a bounded empirical case within which the phenomenon of artisanal mining and its impacts could be examined in depth. The case study approach is well established in social science research involving complex, context-dependent phenomena where the goal is to develop holistic understanding rather than to produce universally generalisable statistical findings (Yin, 2018). By focusing intensively on a single district, the study can trace the interconnections between mining activity, household economics, social dynamics, environmental conditions, and governance responses in ways that cross-sectional survey research spread across multiple sites would not permit.

3.5 Research Approach

A sequential explanatory mixed-methods approach was adopted, in which a quantitative data collection phase preceded and informed a qualitative phase. In the first phase, structured household questionnaires generated numerical data on participation patterns and perceived impacts, allowing for descriptive statistical analysis and the identification of broad patterns across the sampled population. In the second phase, key informant interviews and focus group discussions provided qualitative depth, enabling participants to elaborate on, contextualise, and explain the statistical patterns observed in phase one. The sequential logic of this design ensures that qualitative inquiry is targeted and theoretically informed by quantitative findings, rather than proceeding in a vacuum (Bryman, 2016; Teddlie & Tashakkori, 2009).

3.6 Target Population

The study's target population encompasses all individuals and institutional actors from whom information relevant to ASM impacts in Bindura District could be obtained. This includes household heads residing in communities adjacent to artisanal mining sites, active artisanal miners engaged in gold extraction and processing, leaders of mining communities including village heads and ward councillors, and officials from regulatory and government bodies with oversight responsibilities, specifically the Zimbabwe Environmental Management Agency (ZEMA), the Ministry of Mines and Mining Development, and Bindura Rural District Council. This purposively broad population definition ensures that the study captures perspectives from those who participate in artisanal mining, those who are affected by it without participating, and those responsible for governing it (Saunders, Lewis, & Thornhill, 2019).

3.7 Sample Size and Composition

A total of sixty-five participants were included in the study, a figure arrived at through a combination of statistical pragmatism and qualitative saturation principles. For the quantitative household survey component, sixty-five respondents constitute a sufficiently large sample for descriptive and preliminary inferential analysis, while remaining manageable within the logistical constraints of field research in a semi-formal community. For the qualitative component, the inclusion of key informants from multiple stakeholder categories, specifically artisanal miners, community leaders, and regulatory officials, ensured that data collection reached thematic saturation, the point at which additional interviews yield no substantively new insights (Israel, 2013).

3.8 Sampling Methods

3.8.1 Purposive Sampling

Purposive sampling was the primary sampling strategy, chosen because the study's objectives demand participants with specific knowledge, experience, or institutional positions relevant to artisanal mining in Bindura. This non-probability technique is standard in qualitative and mixed-methods research where the goal is to access information-rich cases rather than to achieve statistical representativeness (Etikan, Musa, & Alkassim, 2016). Specifically, purposive sampling was used to identify and recruit key informants from regulatory agencies, community leadership structures, and experienced artisanal miners whose in-depth knowledge could illuminate governance dynamics and community-level impact experiences in ways that random selection would not guarantee.

3.8.2 Convenience Sampling for Survey Component

For the household questionnaire component, elements of convenience sampling were applied, selecting households accessible at the time of fieldwork within identified mining-adjacent communities. While this approach limits formal claims to statistical representativeness, it is appropriate for generating preliminary quantitative data in a community where the population is geographically dispersed and seasonally mobile, making complete enumeration or random sampling impractical.

3.9 Data Collection Methods

3.9.1 Structured Questionnaires

Household questionnaires were administered to sixty-five respondents including household heads and active artisanal miners. The instrument was structured primarily around closed-ended Likert-scale items measuring perceived socio-economic and environmental impacts,

supplemented by multiple-choice demographic items and a small number of open-ended questions capturing unanticipated responses. Questionnaires were administered face-to-face by the researcher, minimising non-response and enabling clarification of unclear items (Brace, 2018).

3.9.2 Key Informant Interviews

Semi-structured interviews were conducted with purposively selected key informants from regulatory agencies, local government, community leadership, and experienced mining operators. The semi-structured format was chosen because it combines the consistency of standardised question areas with the flexibility to pursue unanticipated but relevant themes that emerge during conversation. This flexibility is essential when investigating regulatory effectiveness and community governance dynamics, where the most analytically valuable insights often surface through probing follow-up questions rather than pre-scripted responses (Gill, Stewart, Treasure, & Chadwick, 2008).

3.9.3 Field Observations

Structured field observations were conducted at selected artisanal mining sites within Bindura District. The researcher used a standardised observational checklist to document visible environmental conditions, including vegetation clearance, water turbidity, open pit formation, and tailings management. Photographic evidence supplemented written notes, creating a visual record of environmental conditions at time of fieldwork. Observational data serve to triangulate self-reported survey and interview data, providing independent evidence of environmental impacts that does not rely on respondent recall or perception (Angrosino, 2007).

3.10 Data Analysis

Quantitative data generated by household questionnaires were processed using descriptive statistical techniques, including frequency distributions, percentage calculations, and mean and standard deviation calculations for Likert-scale items. Results are presented in tables, bar charts, and pie charts to facilitate interpretation. Qualitative data from interviews and observations were analysed through thematic content analysis, involving initial transcription, iterative reading to identify recurring patterns, coding of meaning units against emergent themes, and synthesis of coded material into coherent thematic narratives (Braun & Clarke, 2019; Saunders et al., 2016). Quantitative and qualitative findings were then integrated in the discussion phase, with each informing interpretation of the other.

3.11 Ethical Considerations

3.11.1 Informed Consent

All participants were fully briefed on the study's purpose, how their information would be used, and their right to decline participation or withdraw at any point without consequence. Written or verbal informed consent was obtained prior to any data collection activity. The principle of informed consent recognises that research participants are autonomous agents whose decision to participate must be genuinely voluntary and genuinely informed, not coerced or obtained through misrepresentation of the research's nature (Denzin & Lincoln, 2011).

3.11.2 Confidentiality and Anonymity

All participant data were treated as strictly confidential. Questionnaire responses and interview transcripts were anonymised during data processing, with no identifying information attached to analytical outputs. The distinction between anonymity, where participant identity is unknown even to the researcher, and confidentiality, where identity is known to the researcher but withheld from public reporting, was carefully maintained. Key informants whose institutional affiliations might identify them were assigned role-based labels rather than named in any documentation (Flemming & Zegwaard, 2018).

3.12 Chapter Summary

This chapter detailed the methodological architecture of the study: a pragmatist philosophy, a case study design, a sequential explanatory mixed-methods approach, purposive and convenience sampling, and data collection through questionnaires, key informant interviews, and field observation. The subsequent chapter presents, analyses, and discusses findings generated through these methods.

CHAPTER 4: DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter presents and analyses the primary data collected from sixty-five household participants through structured questionnaires, supplemented by qualitative insights from key informant interviews and field observations. Findings are organised around the four research objectives: household participation patterns, perceived socio-economic impacts, perceived environmental impacts, and the effectiveness of regulatory frameworks. Quantitative findings are presented through descriptive statistical summaries, tables, and charts, while interview excerpts provide qualitative texture and contextual depth. Where relevant, findings are discussed in relation to the empirical literature reviewed in Chapter Two to identify convergences and divergences with existing scholarship.

4.2 Demographic Profile of Participants

Before examining substantive findings, it is useful to understand the demographic composition of the study's participants. Table 4.1 presents a summary of key demographic attributes across the sixty-five respondents.

Table 4.1: Demographic Profile of Respondents (N = 65)

Category	Attribute	Frequency (%)
Gender	Male	49 (75%)
	Female	16 (25%)
Age	18–30 years	5 (8%)
	31–40 years	24 (37%)
	41–50 years	20 (31%)
	51–60 years	10 (15%)
	61 years and above	6 (9%)
Education	Primary School	3 (5%)
	Ordinary Level	31 (48%)
	Advanced Level	21 (32%)
	Tertiary / Vocational	10 (15%)
Primary Income Source	Artisanal Mining	41 (63%)
	Farming	3 (5%)

Category	Attribute	Frequency (%)
	Formal Employment	7 (11%)
	Informal Trading	14 (21%)

4.2.1 Gender Distribution

The sample was predominantly male (75%, n=49), with women constituting approximately one-quarter of respondents (25%, n=16). This gender imbalance reflects the structural gendering of artisanal mining in Zimbabwe and across the sub-Saharan region, where men dominate physically intensive extraction roles while women cluster in processing, washing, and trading activities. The finding aligns with Amponsah-Tawiah and Dartey-Baah (2022), who similarly documented male dominance in Ghanaian artisanal gold mining, and with research by Arthur-Holmes and Abrefa Busia (2023) emphasising how gender dynamics shape both participation rates and role allocation within ASM. Despite the numerical minority, women's 25% representation in this sample is noteworthy given that national-level estimates for Zimbabwe place female involvement in some mining districts as low as 2.5% (Guma, 2025), suggesting that Bindura women may be particularly active in the sector relative to national norms.

4.2.2 Age Distribution

The age distribution confirms that artisanal mining in Bindura draws primarily from the working-age adult population. The 31 to 40 and 41 to 50 age brackets together account for 68% of the sample (n=44), reflecting the physical demands of extraction work and the life-stage at which household financial pressures, including school fees, house construction, and family maintenance, are most acute. The relatively low representation of 18 to 30 year-olds (8%, n=5) may reflect higher educational participation rates among younger people in the district, or the tendency for youth to attempt other economic strategies before defaulting to artisanal mining. This is consistent with the literature suggesting that ASM is often, though not always, adopted as a calculated livelihood strategy after other options have been exhausted.

4.2.3 Educational Attainment

A striking feature of the sample's educational profile is that 80% of respondents have completed at least Ordinary Level secondary education (n=52), with a further 15% holding tertiary or vocational qualifications. This challenges the common stereotype of artisanal miners as poorly educated individuals with no alternative skills. The finding resonates with Zimusi, Moyo, and

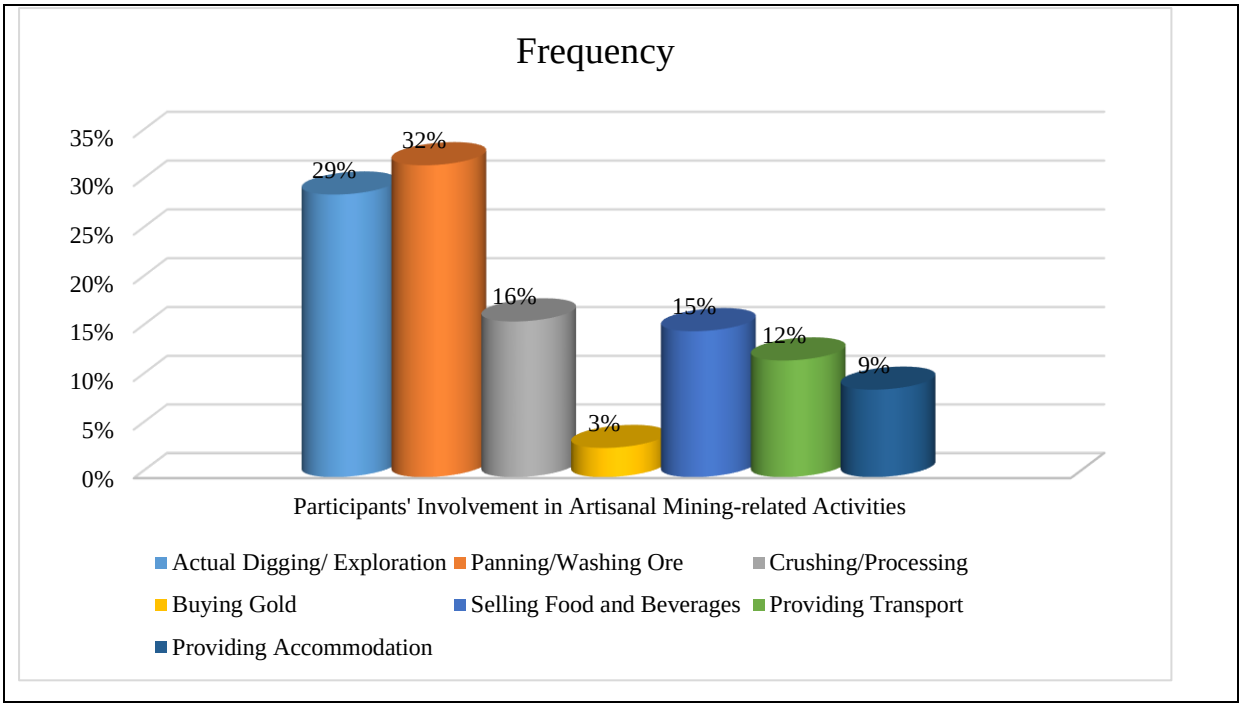
Zimusi (2023), who similarly documented high literacy rates among artisanal miners in Mzingwane District, and with the broader scholarly argument that formal sector failure, rather than individual educational deficit, explains the expansion of ASM in Zimbabwe. The presence of tertiary-educated participants in the sample is a particularly powerful indicator of systemic formal economy failure: these individuals possess credentials that should open doors to formal employment but have turned to artisanal mining because those doors remain closed.

4.2.4 Primary Income Source

Artisanal mining was identified as the principal household income source by 63% of respondents (n=41), followed by informal trading (21%, n=14), formal employment (11%, n=7), and farming (5%, n=3). The dominance of mining as a primary income strategy confirms that, for a substantial majority of the sampled population, artisanal mining is not supplementary but constitutive of household economic welfare. This is consistent with Mkodzongi and Gukurume (2023), who documented similar primary reliance on artisanal mining among households along Zimbabwe's Great Dyke chrome mining corridor.

4.3 Household Participation in Artisanal Mining

All sixty-five households confirmed that at least one member had either direct or indirect involvement in artisanal mining-related activities. Respondents were invited to identify all applicable categories of involvement, enabling multiple selections per household. The distribution of involvement types is presented in Figure 4.1 below.



[Figure 4.1: Frequency of Involvement in Artisanal Mining-Related Activities (N = 65)]

The participation profile reveals that direct extraction activities dominate: 32% of reported involvements relate to actual digging and prospecting, 29% to alluvial panning and ore washing, and 16% to crushing and processing at hammer mills. These three direct extraction categories together account for 77% of reported involvements, confirming that the majority of household engagement with the sector is hands-on and physically demanding.

Beyond direct extraction, the data reveal a significant indirect economy. Gold buying accounts for 3% of involvements, food and beverage vending to miners for 15%, pirate taxi services (locally termed 'mushikashika') for 12%, and accommodation provision to miners for 9%. These indirect roles, collectively representing over a third of household income strategies, are significant because they are often overlooked in regulatory and research frameworks that focus exclusively on direct mining activity. A key informant from a mining community captured the breadth of this economic ecosystem vividly:

"*Vanhu vari muno vechidiki vakawanda vari kuita zvechikorokoza izvozvi, vamwe vanonochera kunzvimbo dzakasiyana-siyana, vamwe vari kuita zvekuyeredza murwizi kuna Mazowe uko then vamwewo ndovari kushanda nezviguru-guru." [Translation: A lot of young people in this community are involved in artisanal mining. Some dig in various mining sites, some do alluvial panning along rivers including the Mazowe, and others work with hammer mills to crush stones and extract gold.]*

This qualitative testimony reinforces the quantitative finding that artisanal mining in Bindura functions as an economic cluster, generating a constellation of direct and ancillary livelihood activities rather than operating as a discrete, isolated economic event. This finding aligns with Hilson and Mondlane (2025), who similarly found that ASM in Mozambique operates as part of a complex household portfolio rather than as a stand-alone activity, and with Mkodzongi and Gukurume (2023), who emphasised that livelihood diversification within and around mining represents a critical household risk management strategy.

4.4 Perceived Socio-Economic Impacts of Artisanal Mining

Table 4.2 presents descriptive statistics for respondents' perceptions of artisanal mining's socio-economic impacts across nine measurement items organised under economic/livelihood and social/community sub-dimensions.

Table 4.2: Perceived Socio-Economic Impacts of Artisanal Mining in Bindura (N = 65)

Statement	Mean	Std. Dev.	% Agree / Strongly Agree	% Disagree / Strongly Disagree
Economic & Livelihood Impacts				
Mining income provides a vital safety net when crop yields fail.	4.22	0.93	86.2%	10.8%
Artisanal mining income surpasses what local formal employment can offer.	4.61	0.49	98.5%	0.0%
Mining income has produced visible improvements in local housing quality.	4.05	1.25	75.4%	13.8%
Artisanal mining has driven up prices for basic goods including food and rent.	4.19	0.77	80.0%	1.5%
Social & Community Impacts				
Artisanal mining has contributed to increased school dropout rates among children.	4.19	0.87	80.0%	3.1%
Crime and theft have increased in this community due to artisanal mining.	4.03	1.10	78.5%	18.5%
Prostitution and teenage pregnancy are noticeably linked to mining activity.	4.52	0.67	96.9%	1.5%

Statement	Mean	Std. Dev.	% Agree / Strongly Agree	% Disagree / Strongly Disagree
Mining income has improved household food security and nutritional status.	4.09	0.89	83.1%	4.6%
Artisanal mining creates employment for women and youth who lack other options.	4.55	0.62	95.4%	1.5%

The data in Table 4.2 reveal a consistent pattern of what can be termed 'bounded economic value': artisanal mining is widely recognised as generating real and significant economic benefits, but those benefits are accompanied by equally widely recognised social costs that erode community welfare in parallel.

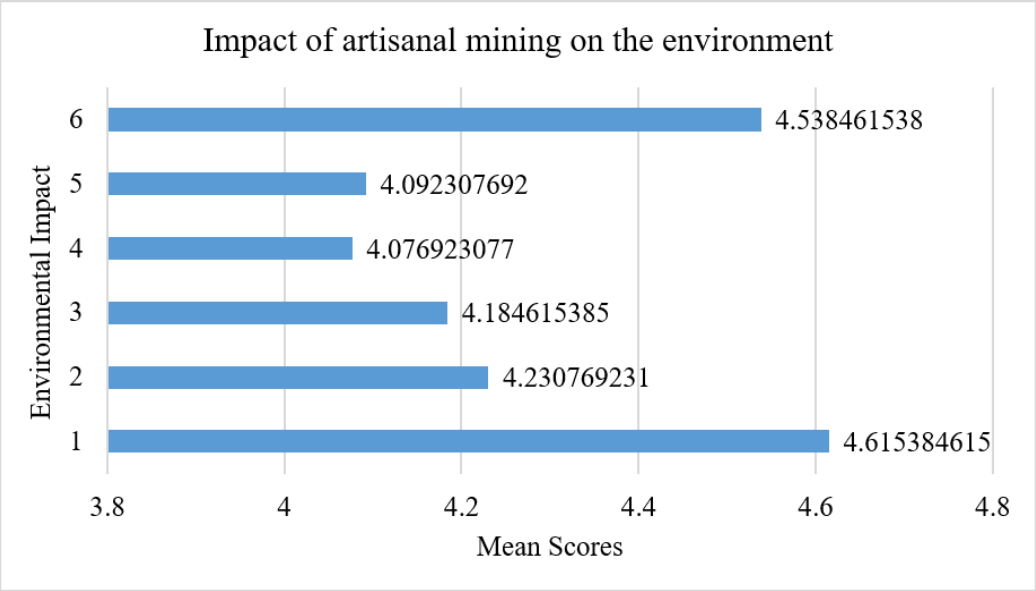
On the economic side, the near-universal consensus that artisanal mining income exceeds local formal employment alternatives (98.5% agreement, Mean = 4.61, SD = 0.49) is particularly striking. The extremely low standard deviation indicates that this is not a contested or polarising assessment but a shared reality across the sampled population. This finding is consistent with Tembo (2022) and with research from comparable Zimbabwean districts confirming that artisanal mining income levels exceed what formal or agricultural employment can offer, at least in absolute terms. The sector's role as an agricultural safety net when harvests fail (86.2% agreement, Mean = 4.22) reflects the climatic vulnerability of the farming systems in which many households are embedded, and its status as an employment generator for women and youth (95.4% agreement, Mean = 4.55) highlights how it fills a gap that neither formal employment nor agriculture can service.

The social cost dimension of the data is equally unambiguous. Almost all respondents associate artisanal mining with increased prostitution and teenage pregnancy (96.9%, Mean = 4.52), rising school dropout rates (80.0%, Mean = 4.19), and higher crime (78.5%, Mean = 4.03). These findings closely parallel research from East African and West African mining settlements that document how rapid social and economic transformation in mining communities generates complex sexual economies, educational disruption, and elevated crime (Bryceson et al., 2013). A key informant articulated this paradox with directness: 'Artisanal gold mining has improved the quality of life for many households in Bindura. It works as a cushion against economic challenges. However, it has its downside effects which include engagement of youths into drugs, dropping out from schools and prostitution.'

The relatively high standard deviation for the housing improvements item (Mean = 4.05, SD = 1.25) compared to other items suggests that mining income's transformation of the built environment is unevenly distributed across the community, with some households experiencing visible upgrading while others remain in poverty despite living in a mining area. This inequality dynamic echoes the 'resource curse' literature at the micro-level and reinforces the need for redistributive policy mechanisms within ASM communities.

4.5 Perceived Environmental Impacts of Artisanal Mining

Respondents rated six environmental impact dimensions using Likert scales. Figure 4.2 displays mean scores for each dimension.



[Figure 4.2: Mean Scores for Perceived Environmental Impacts of Artisanal Mining in Bindura]

The environmental impact data reveal a hierarchy of concern that reflects both the visibility and the immediacy of different impact types. Mercury leakage and contamination registered the highest mean score (M = 4.62), a result that reflects genuine community awareness of mercury's role in local gold processing and the health risks it generates. This finding is contextually significant given UNEP's (2024) estimate that approximately 96% of artisanal gold processing globally continues to rely on mercury amalgamation. Community members' high concern about mercury is well-founded and suggests a degree of risk literacy that governance frameworks have not yet successfully channelled into behaviour change.

Deforestation and vegetation clearance registered the second highest mean concern score (M = 4.23), which is consistent with the visible and proximate nature of tree loss around mining sites.

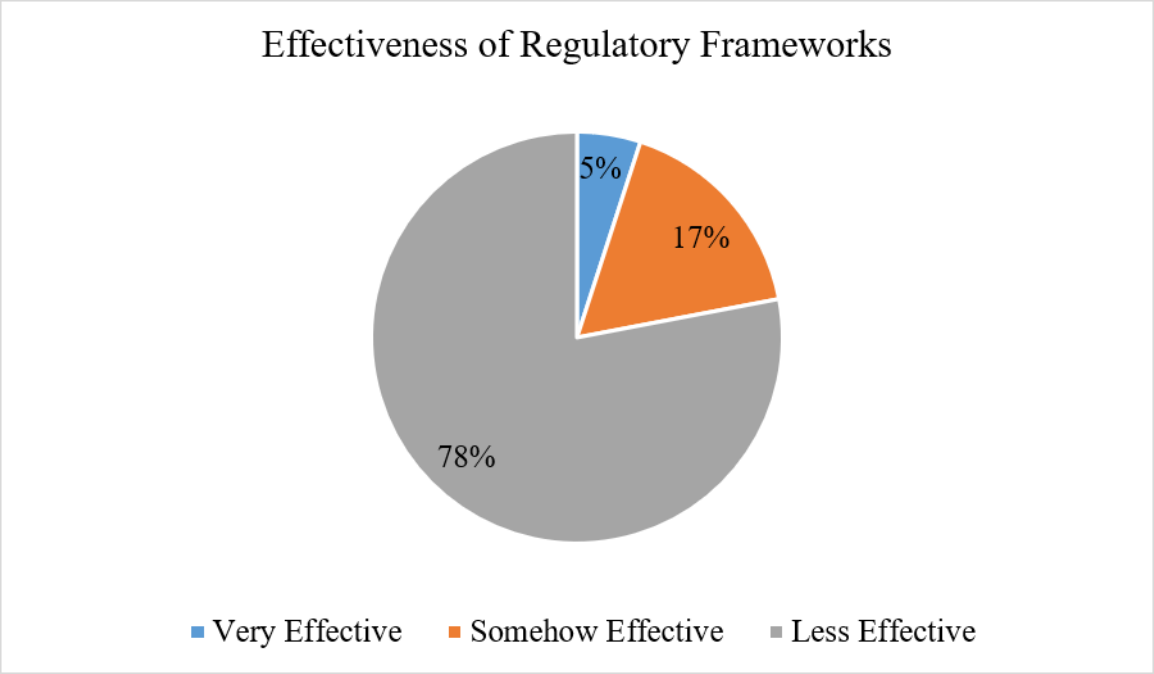
Unlike mercury contamination, which operates through largely invisible chemical pathways, deforestation is immediately observable and is experienced as a direct assault on landscape familiarity and agricultural resource availability. Associated health risks from mercury exposure, silica dust, and open pit accidents scored highly at M = 4.54, indicating that community members accurately perceive the occupational and environmental health consequences of artisanal mining.

Soil erosion (M = 4.09) and river and stream degradation (M = 4.08) registered the lowest mean scores among the environmental impact dimensions, though both remain well above the scale midpoint, indicating significant concern. The relatively lower salience of these impacts compared to mercury and deforestation likely reflects their slower, more diffuse character: erosion and stream degradation accumulate gradually rather than manifesting as immediate, dramatic events, making them less psychologically salient even when objectively serious. This attentional bias has implications for environmental awareness and community advocacy work, which may need to make the cumulative costs of gradual degradation more tangible and visible to community members.

Open pit safety hazards (M = 4.18) occupy a middle position in the hierarchy, reflecting the real and regular danger that abandoned and active mine excavations pose to pedestrians, livestock, and particularly children in the surrounding community. Field observation during data collection confirmed the presence of multiple unfenced open excavations in close proximity to residential areas and footpaths, corroborating the quantitative concern expressed by respondents.

4.6 Effectiveness of Regulatory Frameworks

The final objective examined community perceptions of how effectively existing governance and regulatory frameworks have reduced the negative impacts of artisanal mining. Figure 4.3 presents the distribution of respondent assessments across three effectiveness categories.



[Figure 4.3: Perceived Effectiveness of Regulatory Frameworks for Artisanal Mining in Bindura (N = 65)]

The findings present an unambiguous verdict on regulatory performance: 78% of respondents characterised existing frameworks as 'less effective', while a further 17% assessed them as only 'somehow effective'. Only 5% of the sample viewed current regulatory arrangements as 'very effective'. Cumulatively, 95% of respondents expressed dissatisfaction with governance performance, representing a near-total loss of community confidence in the regulatory system's capacity to deliver meaningful outcomes for either environmental protection or social welfare.

This finding is consistent with the broader scholarly literature on ASM governance in sub-Saharan Africa, which consistently identifies weak enforcement, institutional resource constraints, corruption, and legislative frameworks ill-suited to the informality of the sector as systemic barriers to effective governance (Ondayo et al., 2025). In Zimbabwe's specific case, the Mines and Minerals Act of 1961 has been repeatedly criticised as architecturally unsuited to regulating ASM, having been designed for a formal large-scale mining industry with very different operational characteristics (Matshona, 2024). The fact that an estimated 85% of artisanal and small-scale gold miners in Zimbabwe remain unregistered and outside any formal compliance framework (Business Daily, 2025) represents both a symptom and a cause of governance ineffectiveness.

The qualitative data from key informant interviews reinforced this quantitative picture. Regulatory officials acknowledged capacity constraints and the difficulties of sustained

enforcement in remote and semi-accessible mining areas. Community leaders described regulatory interventions as episodic and reactive rather than proactive and developmental, focused on raids and temporary displacement of miners rather than on addressing the root economic conditions that drive ASM participation. This governance approach not only fails to reduce environmental or social impacts but may actively undermine community trust in state institutions.

4.7 Chapter Summary

The data presented in this chapter paint a coherent and concerning picture of artisanal mining in Bindura District. Household engagement with the sector is near-universal and economically significant, generating income that demonstrably exceeds formal employment alternatives. Yet this economic contribution is accompanied by tangible social costs, including rising crime, school dropout, gender exploitation, and community health burdens, and by measurable environmental damage across multiple dimensions. Regulatory frameworks are perceived as almost comprehensively ineffective. The concluding chapter draws these findings together into conclusions and recommendations for policy, community practice, and future research.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This final chapter synthesises the study's principal findings, draws conclusions grounded in the evidence gathered from Bindura District, and proposes recommendations for policy, community practice, and future research. The chapter is organised to address each research objective in turn before offering broader reflective commentary on what the findings mean for artisanal mining governance and community development in Zimbabwe.

5.2 Summary of Key Findings

The study's first finding is that household participation in artisanal mining in Bindura District is both widespread and structurally diverse. Every sampled household reported at least one member with direct or indirect involvement in mining-related activity, confirming that artisanal mining has become a foundational feature of local economic life rather than a fringe or supplementary activity. Direct extraction roles including digging, panning, and crushing dominated participation, but a significant secondary economy of support services, encompassing food vending, transport, gold buying, and accommodation provision, employs a substantial share of the community alongside the mine face.

The second finding concerns the dual character of socio-economic impacts. Artisanal mining generates income that virtually all respondents confirmed exceeds formal employment alternatives and serves as a crucial buffer against agricultural failure. The sector provides particular economic value for women and youth who face structural exclusion from formal labour markets. Simultaneously, the sector is associated with serious and widely perceived social costs: elevated crime, educational disruption through school dropout, gender exploitation, and social problems including prostitution and teenage pregnancy. These economic benefits and social costs are not sequential or separable; they co-exist and are experienced simultaneously by the same communities.

The third finding relates to environmental impacts. Respondents identified mercury leakage and contamination as the most serious and concerning environmental problem generated by artisanal mining in Bindura, consistent with global evidence on mercury's dominant role in ASM's environmental footprint. Deforestation and health risks were assessed as the next most serious concerns, followed by open pit safety hazards, soil erosion, and river degradation. Across all six environmental dimensions assessed, respondents registered significant concern,

indicating that environmental deterioration is broadly perceived and not limited to any single impact pathway.

The fourth finding is that regulatory and governance frameworks are assessed by the vast majority of community members as ineffective. Only five percent of respondents considered current arrangements to be working well. This near-total community rejection of governance performance reflects documented structural failures including outdated mining legislation, enforcement resource constraints, episodic rather than systemic regulatory approaches, and a fundamental mismatch between enforcement-focused governance strategies and the developmental conditions that drive artisanal mining participation.

5.3 Conclusions

Taken together, these findings support the conclusion that artisanal mining in Bindura District occupies a structurally ambiguous position in local development: it is simultaneously essential and harmful, economically enabling and socially and environmentally corrosive. This ambiguity makes the policy challenge genuinely difficult. The sector cannot be straightforwardly suppressed without removing a livelihood mechanism on which a substantial portion of the district's population depends. Nor can it be unreservedly promoted without accepting ongoing environmental damage and social disruption as acceptable collateral costs of economic activity.

The study confirms that Sustainable Development Theory's insistence on the integrated treatment of economic, social, and environmental pillars is not merely an academic preference but a practical necessity. Evaluating artisanal mining through an economic lens alone produces an unjustifiably positive picture; evaluating it through an environmental lens alone produces an unjustifiably negative one. Only by holding all three pillars in view simultaneously can analysts and policymakers develop responses proportionate to the complexity of the situation. The evidence from Bindura suggests that current policy approaches, which tend to oscillate between permissiveness and enforcement rather than pursuing integrated developmental governance, are inadequate to this complexity.

The near-total community rejection of regulatory effectiveness is itself a finding that deserves policy attention. Regulatory frameworks that lack community confidence are likely to be actively circumvented, reducing their already-limited effectiveness still further. Building governance systems that are perceived as legitimate by mining communities requires not only technical improvements to enforcement but substantive shifts in how governance is

conceptualised, moving from adversarial compliance enforcement toward collaborative developmental partnership.

5.4 Recommendations

5.4.1 Policy Recommendation: Prioritise Formalisation Through Inclusive Registration

The most urgent policy intervention required is a comprehensive, accessible, and community-sensitive formalisation programme for artisanal miners in Bindura District and comparable areas across Zimbabwe. Formalisation, through streamlined registration processes, designated mining areas with clear land tenure arrangements, and simplified compliance requirements calibrated to the realities of small-scale operations, would bring currently unregistered miners within the regulatory system. This would enable environmental monitoring, allow for taxation and revenue sharing that could fund community development and land rehabilitation, and create a foundation for delivering occupational health and safety training to previously ungoverned practitioners. The Mines and Minerals Act should be comprehensively updated to create a dedicated, fit-for-purpose regulatory chapter for the ASM sector.

5.4.2 Community Practice: Establish Environmental Rehabilitation Committees

Community leadership in Bindura's mining areas should facilitate the establishment of community-based environmental management and rehabilitation committees that include active miners, community representatives, women's groups, and youth organisations. These committees would assume collective responsibility for monitoring and addressing environmental degradation at the local level, advocating for abandoned pit rehabilitation, and promoting responsible waste management and mercury reduction practices. Grounding environmental stewardship in community structures rather than exclusively in state agencies increases the likelihood of sustained engagement and builds the social capital that formal governance alone cannot generate.

5.4.3 Mercury Reduction and Safer Processing

Government agencies and development partners should collaborate to introduce mercury-free or low-mercury gold processing technologies to Bindura's artisanal mining communities. Technologies including retort systems that recover and recycle mercury, and gravity concentration methods that reduce reliance on chemical amalgamation, are available and have been successfully introduced in other ASM contexts. Technology transfer programmes should be accompanied by practical training, demonstration, and economic incentives that make adoption rational for miners rather than merely morally exhorted.

5.4.4 Social Support Interventions

The documented links between artisanal mining, school dropout, and social vulnerability, particularly among women and youth, call for targeted social interventions in mining communities. These should include school retention programmes for children in mining families, vocational training opportunities for youth that create credible alternatives to mining, and gender-sensitive support services for women in the sector. These interventions address the social costs of artisanal mining without requiring mining itself to be eliminated.

5.4.5 Future Research

Several analytical gaps identified by this study warrant investigation in future research. Longitudinal studies tracking the same households over five to ten years would enable assessment of whether artisanal mining income generates durable asset accumulation and human capital investment or merely sustains consumption without building long-term welfare. Research is also needed on the indirect livelihood economy around mining, specifically quantifying the income, employment, and economic multiplier effects of vending, transport, accommodation, and gold trading activities. Additionally, comparative research examining governance effectiveness across different Zimbabwean districts with different regulatory histories would generate more robust evidence on which governance approaches produce better outcomes.

5.5 Concluding Remarks

Artisanal mining in Bindura District is neither a problem to be eliminated nor a panacea for rural poverty. It is a complex, structurally embedded livelihood strategy that generates real economic value for households while imposing equally real costs on the environment and social fabric. Addressing this complexity requires governance approaches that are simultaneously more developmental and more effective than current frameworks provide: frameworks that meet miners where they are, engage communities as partners rather than adversaries, and pursue the integration of economic welfare, social justice, and environmental sustainability that the sustainable development agenda demands. This study contributes to the evidence base on which such frameworks can be built.

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APPENDIX 1: QUESTIONNAIRE FOR ASSESSING THE IMPACTS OF ARTISANAL MINING IN BINDURA DISTRICT

Department of Sustainable Development, Bindura University of Science Education

Introduction and Consent

I am an undergraduate student in the Department of Development Studies. This questionnaire is strictly for academic purposes to fulfill the requirements of my Honours Degree. The information you provide will be treated with **strict confidentiality and anonymity**. You are not required to write your name. Participation is voluntary, and you may withdraw at any time. Do you consent to participate? ( ) Yes ( ) No

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SECTION A: DEMOGRAPHICS

Instructions: Please tick [✓] the appropriate box or fill in the blank.

A1. Gender: [ ] Male [ ] Female

A2. Age Group
[ ] 18-25 Years
[ ] 26-35 Years
[ ] 36-45 Years
[ ] 46-55 Years
[ ] 56+ Years

A3. Ward/Area of Residence in Bindura: _____

A4. Highest Level of Education Completed

[ ] No Formal Schooling
[ ] Primary School (Grade 7)
[ ] ZJC / Form 2
[ ] O-Level
[ ] A-Level
[ ] Tertiary / Vocational

A5. What is the primary source of income for this household?
[ ] Artisanal Mining
[ ] Subsistence Farming
[ ] Formal Employment
[ ] Informal Trading/Vending
[ ] Remittances from Diaspora
[ ] Other (Please Specify): _____

SECTION B: PARTICIPATION IN ARTISANAL MINING

B1. Is any member of your household currently involved in artisanal mining activities (gold panning, digging, processing, or selling supplies to miners)?

[ ] Yes

[ ] No *(If No, Skip to Section B)*

B2. If **Yes** to A6, what is the nature of this household member's involvement? *(Tick all that apply)*

[ ] Actual Digging/Extraction

[ ] Panning/Washing Ore

[ ] Crushing/Processing (Amagweja/Makorokoza)

[ ] Buying Gold (Local Buyer/Sponsor)

[ ] Selling Food/Water/Supplies to miners

[ ] Providing Transport (Mushika-shika)

B3. How many months per year does the household rely on income from artisanal mining?

[ ] All year round [ ] 6-9 months [ ] 3-6 months [ ] Less than 3 months (Seasonal only)

SECTION C: PERCEIVED SOCIO-ECONOMIC IMPACTS

(Addresses Objective ii & Research Question ii)

Instructions: Please indicate the extent to which you **Agree or Disagree** with the following statements about mining in **your community**.

(Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Statement	1	2	3	4	5
Economic & Livelihood Impacts					
C1. Artisanal mining provides a vital safety net when crop yields fail.					
C2. Income from artisanal mining is higher than what one can earn from local formal jobs.					
C3. The money from mining has led to visible improvements in housing structures in my area.					
C4. Artisanal mining has caused local prices for basic goods (food, rent) to increase significantly.					
Social & Community Impacts					
C5. Artisanal mining has increased the rate of **school dropouts** among local children.					
C6. Artisanal mining has led to an increase in **crime and theft** in this community.					
C7. There is a noticeable problem with **prostitution/teenage pregnancy** linked to mining activities.					

C8. The activity has improved household **food security** and nutrition for families.					
C9. Artisanal mining provides employment opportunities for women and youth who have no other options.					

SECTION D: PERCIEVED ENVIRONMENTAL IMPACTS OF ARTISANAL MINING IN BINDURA

(Addresses Objective iii & Research Question iii)

Instructions: Please indicate the extent to which you **Agree or Disagree** with the following statements.
(Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Statement	1	2	3	4	5
Land and Water					
D1. Artisanal mining has caused widespread **deforestation** and loss of vegetation in Bindura.					
D2. The quality of water in local rivers/streams has **deteriorated** due to siltation and chemical use.					
D3. Open pits and trenches left by miners pose a serious **safety hazard** to people and livestock.					
D4. Artisanal mining is a direct cause of **soil erosion** and loss of arable land in this district.					
Health and Safety					
D5. The use of **mercury** (quicksilver) is common in gold processing in this area.					
D6. I am aware of specific **health risks** associated with inhaling dust from crushing sites or handling mercury.					

SECTION E: EFFECTIVENESS OF CURRENT REGULATORY FRAMEWORKS FOR REDUCING ADVERSE IMPACTS OF ARTISANAL GOLD MINING

D3. Are you aware of any **Formalization** or **Registration** initiatives by the government (e.g., Mining Syndicates/Co-operatives) in Bindura?
[ ] Yes, they are active in my area.
[ ] I have heard of them, but they are not present here.
[ ] No, I am not aware of any.

E1. Effectiveness of Current Approaches

Please indicate your level of agreement with the following statements about the current **enforcement and management** of artisanal mining.

Statement	1	2	3	4	5
E1a. Current laws have successfully **reduced** the environmental damage caused by artisanal miners.					
E1b. The policing approach (raids/arrests) is effective in stopping illegal mining in the long term.					
E1d. The government is effective on **supporting and training** miners rather than just punishing them.					

D5. In your opinion, what is the **single most important** thing the government or local council should do to manage artisanal mining in Bindura better? (Choose ONE)

……

END OF QUESTIONNAIRE

THANK YOU!!