

BINDURA UNIVERSITY OF SCIENCE EDUCATION

A SMART ARCHITECTURE FOR SUSTAINABLE DEVELOPMENT IN THE ARTISANAL AND SMALL-SCALE MINING SECTOR IN KADOMA DISTRICT

BY

LANGATON MABHANGA

B230176A

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APPROVAL FORM

The undersigned certify that they have read and recommended to Bindura University of Science Education (BUSE) for acceptance a Dissertation entitled **"A SMART ARCHITECTURE FOR SUSTAINABLE DEVELOPMENT IN THE ARTISANAL AND SMALL-SCALE MINING SECTOR IN KADOMA,"** by **Langaton Mabhanga** in partial fulfillment of the requirements for the degree of **Master of Leadership and Corporate Governance**.

Student: Langaton Mabhanga Signature: 1 Date: 1.02.2024

Supervisor M. Matambo Signature:  Date: 23.6.2024

GSB Director Signature: …… Date: ……

……..… Signature: …… Date: ……

Faculty Chairperson

…….. Signature: …… Date: ……

External Examiner

RELEASE FORM

NAME OF AUTHOR: LANGATON AMBHANGA

STUDENT NUMBER: B230176A

TITLE OF DISSERTATION: **A SMART ARCHITECTURE THAT ADDRESSES THE DEARTH OF SUSTAINABLE DEVELOPMENT IN THE ARTISANAL AND SMALL-SCALE GOLD MINING ECONOMY IN ZIMBABWE. A CASE OF KADOMA DISTRICT**

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Signature: **Date**: 22 JANUARY 2024

Permanent Address: 4904 Mornington Park, Kadoma, Zimbabwe

E-mail: langton@onpoint-zim.com

Cell Number: +263772317793

DECLARATION

I, Langaton Mabhanga Student Reg Number B230176A, do hereby declare that this dissertation is a result of my investigation and research, except to the extent indicated in the acknowledgments, bibliography, references, and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.

STUDENT SIGNATURE **DATE: 22 JANUARY 2024**

DEDICATION

This work is dedicated to the thousands of artisanal and small-scale miners who contribute so much to the fiscus yet are so little recognised, my Daughters, and my Mum who departed from earth while in my midstream of studies of this program.Thank you, Mum – May your dear Soul rest in eternal peace.

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ABSTRACT

This research explored the conceptualization of a smart architecture for sustainable development in Artisanal and Small-scale Gold Mining (ASGM). It applied the Natural Resources Curse Theory and the Driving Forces - Pressures - State of the Environment - Impacts – Responses theories to evaluate the ASGM activities against the dimensions of sustainable development that have been identified as economic, social, and environmental. The goal was to create a balanced ecosystem that promotes human livelihoods, while ensuring ecological, and economic viability. The study examined the sustainability of the ASGM in Wards 14, 15, and 16 also known as Chakari within the Kadoma District, Mashonaland West Province, Zimbabwe. The strategies and methods employed in ASGM activities and how they affect sustainable development were interrogated and analysed. Qualitative data were gathered by interviewing the ASGM operators, community leaders, Ministry of Mines officials, and the officers from EMA. The findings of the study revealed that the ASGM activities permitted the operators to access quite some amount of gold ounces since the combined ASGM sector contributed above 60% of the total country's gold output sold to the RBZ via Fidelity Printers and Refinery. However, the ASGM players have not been significantly contributing to the local sustainable development agenda through effective rehabilitation of their mined-out areas which have become extensively degraded with risks to animals, children, and human health. The integration of digital broadband services, especially with satellite broadband, such as the high-speed Star Link would constitute the centrepiece of a multi-faceted application to scale sustainable development in the ASGM sector.

Keywords: Artisanal and Small-scale Gold Mining, Kadoma District, Mashonaland West Province, Sustainable development, Zimbabwe

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ABBREVIATIONS

AcFTA	African Continental Free Trade Agreement
ASGM	Artisanal and Small-scale Gold Mining
ASSM	Artisanal and Small-Scale Mining
BUSE	Bindura University of Science and Education
CSOT	Community Share Ownership Trust
DPSIR	Drivers-Pressure-State-Impact-Response
EEA	European Environment Area
EMA	Environmental Management Agency
EPA	Environmental Protection Agency
FPR	Fidelity Printers and Refinery
GPS	Global Positioning System
ILO	International Labour Organization
LSM	Large-scale Mining
MoMMD	Ministry of Mines and Mining Development
NDS	National Development Strategy
NSSA	National Social Security Authority
OECD	Organisation of Economic Co-operation and Development
PAYE	Pay As You Earn
PPE	Personal Protective Equipment
RBV	Resource-Based View
RBZ	Reserve Bank of Zimbabwe
RDC	Rural District Council
RRA	Rapid Rural Appraisal
SCOT	Strength Challenges Opportunities Threats
SDG	Social Development Goals
SME	Small to Medium Enterprises
UN	United Nations
UNICEF	United Nations Children's Fund
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
WiFi	Wireless Fidelity
ZEPARU	Zimbabwe Economic Policy Analysis Review Unit

ZIMRA	Zimbabwe Revenue Authority
ZMDC	Zimbabwe Mining Development Corporation
ZNOSHP	Zimbabwe National Occupational Safety and Health Policy
ZRP	Zimbabwe Republic Police

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

The study aimed to conceptualise the smart architecture for sustainable development in the Artisanal and Small-scale Gold Mining (ASGM) sector by researching the effects, impacts, strategies, and, methods of the ASGM activities. This chapter provides the background that highlights the environmental and social challenges in the ASGM sector, justifying the need for further research. The statement of the problem is given and the necessity for academic intervention is shown. Research objectives that steered and propelled this academic pursuit in search of viable solutions are outlined as well the significance of the study.

1.2 BACKGROUND OF THE STUDY

The Paradox of ASGM as a resilient sector, juxtaposed with the large-scale producers affected by power outages, capital shortages, and foreign currency shortfalls, with no known affirmative and inclusive funding models that are proportionate to deliveries, underscores the critical role of the ASGM in Zimbabwe's economy. The sector is affected by numerous fatalities due to falls of ground, shafts, and flooding with no known prequalification of formal training (Zimbabwe Chamber of Mines, 2023). The prevalence of damage to agricultural land cases, with no known mechanisms for either restraint or rehabilitation (Siduduziwe Ncube-Phiri, 2015), the proliferation of unplanned habitat settlements, farming-mining land, and boundary disputes require a smart architecture to distinctly determine land use accordingly. There are also economic factors relating to the ASGM activities in the production of gold, marketing and smuggling, productivity, and effects on livelihoods and local economies. The escalating statistics of fatalities in ASGM are a trigger for academic inquiry.

Four percent of the world's population directly relies on artisanal mines and contributes to twenty percent of the global minerals (Victoria Girrard, 2018). ASGM sector directly employs 500,000 people, but this number can more than be doubled amid increased deindustrialization in Zimbabwe, (Zimbabwe Chamber of Mines, 2023). Mining in Zimbabwe is in different categories, the top being the dominantly exotic Conglomerate Mining Houses that have a throughput production that runs into several hundreds of

thousands of metric tons of mineral production per annum, (ZIMPLATS, 2022). The Annual Integrated Report revealed that, as an entity, it generated a US$ 1.4 billion turnover in 2021. The middle layer of the industry constitutes the middle layer production of several tens of thousands in gold, chrome, and the high capital investment platinum projects still in progress, such as Karo and Great Dyke Investments. Others are Golden Valley Mine, RioZim and the latest entry, Kuvimba Mining, mainly consisting of the former Zimbabwe Mining Development Corporation (ZMDC), a quasi-government company. The bottom layer will be the core study of this study, the small-scale artisanal miners. The ultra-hazardous conditions that make up the operating environment of this sector continue to escalate with little concern for the environment over the last decade, attracting research, but little has been done to proffer executable strategies to tame what has become the bloodiest jungles of the last decade. The inflictions of injuries and multiple fatal incidents of underground failures continue to escalate. Incidents of fatalities owing to flooding of shafts sunk along waterways, severe land and environmental degradation, and acute unreported and reported injuries continue to affect the artisanal miners. Multiple fatalities, bloody criminality, illegal mineral flight to foreign countries, and several cases of gold smuggling have been reported in several quaternary sources in Zimbabwe, in some instances assisted by the security agency in South Africa to apprehend the smugglers.

The reports of the Zimbabwe Mining Federation leaders' case were substantiated by the Zimbabwe Environmental Lawyers Association (ZELA) as recently as on the 20th of November 2020 (Zimbabwe Environmental Lawyers Association, 2020), in an independent professional and investigative report. The report reveals and confirms the existentially weak policies, controls, and attributes; most of the gold smuggled to South Africa and Dubai to be gold proceeds from the ASGM sector. Thus, this study provided the less traversed leadership in tackling the overweighing ramifications of the high gold production by the artisanal and small-scale gold mining sectors. Thus, the ASGM activities were weighed in the context of sustainable development. The ASGM's gold deliveries to Fidelity Printing and Refinery (FPR), the government's official gold marketing platform, amounted to 65% of total deliveries at 24 tons of aggregate of 37 tons in 2022, while the large-scale primary producers delivered 11 tons during the same period, with the balance coming from secondary producers, the paradox of the economic significance of the sector and the clumsy working and living conditions, and ecological damages. The ASGM habitats without basic services such as potable water, roads, and electricity pose an immense threat to outbreaks of diseases such as

cholera and typhoid. Lack of maternity facilities, pediatric care, and sexually transmitted ailments treatment can trigger chronic ailments (Zvarivadza, 2018). The widespread use of dangerous chemicals such as mercury and sodium cyanide expose artisanal miners to chronic diseases. Direct handling and application of these chemicals with limited or no personal protective equipment and training render the miners vulnerable to diseases (Franklin Schwartz, 2021). The infringement of property rights coupled with weak restraint mechanisms of the regulatory authority is a side of ASGM activities that is exacerbated by weak and lengthy property tenure and boundary dispute resolution. Furthermore, the mining of gold on unauthorised claims could border on violation of property rights that can dent the national investment confidence index score and potentially render the mining field into bloody high conflict hot spots (Freudenberger, 2013). Existential weak health, education, potable water, telecommunication, and digital infrastructure are all associated with the close ecosystem of ASGM. Thus, the imminent demand for smart architecture that can spur Sustainable Development through this study, seeks to close the identified wide gap**.**

1.3 STATEMENT OF THE PROBLEM

The main problem is the intricate comparison between the ability of the Artisanal and Small-scale Gold Mining (ASGM) industry to withstand unfavorable circumstances and the difficulties large-scale producers encounter, such as power outages, financial constraints, and foreign exchange deficits, (The Chamber of Mines of Zimbabwe, 2022). This contradiction highlights the importance of ASGM to Zimbabwe's economy. Notwithstanding its significance, ASGM is beset by several issues, including fatalities, harm to farmland, haphazard habitat settlements, and border conflicts, all of which are exacerbated by a lack of official training and infrastructure. The repercussions on lives and local economies, together with the economic impact of smuggling, marketing, and gold extraction, emphasize the urgent need for more research. Addressing these concerns is critical since a sizable section of the population depends on ASGM and contributes to the world's mineral output. Significant dangers also arise from the sector's effects on the environment and people’s health, including the use of hazardous chemicals such as mercury, and inadequate medical treatment, (Global Mercury Partnership, 2020). These issues are made worse by lax regulatory frameworks and violations of property rights, which can undermine national investor confidence and escalate hostilities, (Mark Freudenberger, 2013). By creating a smart architecture that supports sustainable development in the ASGM industry, the research seeks to solve these complex

concerns, close current gaps, and advance holistic growth. Whereas the ASGM sector contributes over 60% of gold deliveries to the fiscus annually, the sector is beleaguered with very dangerous operating conditions, poor infrastructure, high fatalities, low, poorly managed funding support channels, and does not exist within any legal framework, (Swiss Better Gold, 2024). In contrast, South Africa recently enacted a basic policy framework called the Artisanal and Small-scale Policy on the 30th of March 2022, (South African Government, 2022).

1.4 RESEARCH OBJECTIVES

The following objectives guided the study on the gold production contribution to sustainable development within the Kadoma District and these were stated as given below:

- To examine the causes and impacts of artisanal mining on sustainable development in Kadoma District.
- To identify strategies used in ASGM in Kadoma District.
- To evaluate strategies used in ASGM in Kadoma District.
- To develop a smart architecture for sustainable development in the ASGM sector.

1.4.1 Research Questions

- What are the causes and impacts of artisanal mining on sustainable development in Kadoma District?
- What are the strategies used in ASGM in Kadoma District?
- What is the smart architecture for sustainable development in the ASGM sector?

1.4.2 Research Propositions

Some research propositions were established for the research and these were confirmed as the research progressed. The propositions consisted of two elements, rational and non-rational.

1.4.3 Research Proposition

A smart architecture mitigates the existential causes, impacts, strategies, and methods of ASGM activities for the sustainable development of Kadoma District.

1.5 RESEARCH ASSUMPTION

The ASGM sector would enhance the sustainable development performance of the Kadoma District, including economic development, environmental protection, and integrated social progress. The ASGM sector possesses the potential to contribute immensely to the national fiscus, as the country has set a target of USD 12 billion. In addition, maximum cooperation from participants in the ASGM sector could reasonably be attained. Finally, it is assumed that ASGM processes and activities remain the same during the period of the research study.

1.6 JUSTIFICATION OF THE RESEARCH

Hove (2020), outlaws any environmental degradation, occupational safety regulated by the National Occupational Safety and Health Policy (ZNOSHP) enacted in 2014 (Mkungunugwa, 2022), Mining inspections, and certification, The Explosives Act, (Nikita Madya, 2024), legal land distribution and offer letters certification requirements, (Chamber of Mines of Zimbabwe, 2022), the rate of environmental degradation, illegal mining, lack of conservative mining, severe conflicts due to farmer-miner disputes, and lack of training of the ASGM miners have continued unabated and this research is critical as it calls on all stakeholders to uphold the fundamental tenets of sustainable development (Mudimu, 2024).

1.7 PURPOSE OF THE STUDY

The study will go beyond prescribing formalization as the primary and absolute intervention, as has been suggested by the reviewed academic journals. Both qualitative and quantitative studies of the sector will provoke a greater, sustained pursuit of a smart architectural solution with grounded academic rigor, to challenge existing literature while creating new academic stock. The latest notable academic attempt to propose a solution to the artisanal mining menace was put forward by the Zimbabwe Economic Policy Analysis Unit, (Zimbabwe Economic Policy Unit, 2018). The study seeks to establish the socioeconomic effects and impacts resulting from ASGM activities. It is especially inclusive as it is being undertaken by predominantly young people and women and thus represents a ‘red ocean’ for social traps as defined by Cowan caused by unintended circumstances with cyclical causatives leading to cumulative anger, frustration, violence, economic despair, and in some cases deepening ethnic polarization (Cowan, 2020). A good example is the MaShurugwi machete gangs which caused turmoil by committing cold-blood killings of ASGM miners. The prospects of

generating an integrated smart architecture that closes the gaps caused by human omission or commission interventions and conduct will enrich Zimbabwe's attainment of VISION 2030.

1.8 SIGNIFICANCE OF THE STUDY

Theory: Literature source

New Literature will be available in the Graduate Business School Library and Internet. The study will contribute to the theoretical framework that can be used to assess economic development. The models generated will demonstrate the impact of a smart architecture for sustainable development of the ASGM activities in Kadoma District.

Contribution to Empirical Studies

Provides future researchers with a guide on methodological and theoretical choices.

Policy and Practice

The recommendations derived from this study will edify new policies on artisanal mining.

Sustainable Development-oriented ASGM Framework

The study will provide a novel framework that will shape ASGM activities that enhance sustainable development.

1.9 DELIMITATIONS

Geographically the research was carried out within the Kadoma Mining District, specifically in Chakari, from January – May 2024. The framework developed is specific to Kadoma district, hence it cannot be replicated in other mining districts. Data was collected from the players within the artisanal and Small-scale Mining sector encompassing the operators, regulators, community, and technological firms as given in more detail in the sampling regimes under Chapter Three.

1.10 RESEARCH LIMITATIONS

There were several constraints such as limited time to carry out the research in reputable libraries such as the BUSE Library and equally credible online libraries and academic sources such as Wiley and ResearchGate. Additionally, the research period fell within the by-elections patch and political polarization but a fully apolitical approach was pursued. The demand to prove and demonstrate that the research had no political motives, or was not related to any political activity was overwhelming. There were also financial resource constraints as the research was not funded by any funding institution, hence lean and affordable options were

executed. There were numerous and lengthy bureaucratic restrictions that hindered free data collection exercises but relied on the accessible yet equally credible targets that were engaged. Another limitation was averse and fear that the ASGM players may be doing illegal mining and are armed as they usually are. However, they were firmly assured that the process was purely academic.

1.11 RESEARCH RATIONALE

Interacting with operators, as a researcher, is fulfilling at the Master's Degree level and practically attempting to strategically address the failed sustainable development matters in the growing ASGM sector throughout Zimbabwe. This academic offering will proffer valuable solutions or provocative academic exchanges towards fostering formidable solutions, that answers to Zimbabwe's Education 5.0. Furthermore, as the findings of this study unfolded, the researcher donated 30,000 tree seedlings (13/04/2024) which were shared among some schools within the Kadoma District in a bid to plant trees and restore the vegetation status, facilitating biodiversity return to such a devastated district.

1.12 DEFINITION OF KEY TERMS

1.12.1. Smart architecture:

A systemic design that is environmentally aware, beyond conservation but energy and materials efficiency, safer systems for people, and the environment, and increased productivity through digital applications that are cognisant of future dynamics, (Van Hinte, 2003).

Sustainable Development:

Interdependency of ecological, social, and economic systems, while meeting the present needs without compromising the capacity of future generations to meet their own needs, (Mensah, Sustainable Development, 2019).

Artisanal and Small-scale Gold Mining (ASGM):

Subsistence-level mining of gold, usually by people who are not formally trained, have no formal technical competence, using own resources, often lacking legal status, environmental safeguards, weak health and safety measures, and limited technologies, (Thomas Hentschel F. H., Artisanal and Small-scale Mining, 2003); (Mwandiringana, 2023).

Gold production: The material output quantity of gold as realised from the related activities of mining, haulage, and mineral processing.

Economic development: Activities by individuals, companies, or the government earmarked to improve wealth accumulation in the local economy.

Environmental protection: Measures taken to ensure that anthropogenic activities' impacts on the environment are minimised, in which the environment means water, soil, air, vegetation, animals, and their interaction with humanity.

Social well-being: Activities to promote human welfare.

Corporate social responsibility: It is a voluntary activity by an organisation in which they decide to plow back part of their company proceeds into the community in which they operate, engaging in projects such as borehole drilling for drinking water for the local people, road maintenance, and school and clinic support.

Kadoma District: It is a geographical region located some 141 kilometers to the west of the capital city, Harare, and shall refer to Chakari in the context of the research.

DISSERTATION OUT LAYOUT

The following is a summary of the chapter contents:

Chapter 1: Introduction

- Introduced the study's background, problem statement, research objectives, questions, and justification. It sets the purpose of the study and its significance for Zimbabwe's Vision 2030.

Chapter 2: Literature Review

- Reviewed existing literature on ASGM, its socioeconomic effects, conflicts, and the regulatory environment. It identifies gaps in current research that this study will address.

Chapter 3: Methodology

- Outlined the research design, population and sampling, data collection and analysis methods, and ethical considerations.

Chapter 4: Findings and Discussion

- Presented the key findings from the data collected, including demographic information, the socioeconomic impacts of ASGM, conflicts, and regulatory issues.

- Interpreted the findings, linking them to the literature. It discussed socioeconomic implications, the role of formalization, strategies to address conflicts and contributions to Vision 2030.

Chapter 5: Conclusions and Recommendations

- Summarized the study's key conclusions, provided recommendations for policy and practice, and suggested directions for future research.

1.13 SUMMARY OF THE CHAPTER

The chapter provided the foundation for research on ASGM activities and their effects on sustainable development a smart model solution. The significance and problem statement were discussed leading to the research objectives and questions amongst other introductory parameters.

CHAPTER TWO

THE LITERATURE REVIEW

2.1 INTRODUCTION

This chapter, focuses on reviewing literature. The theoretical framework is presented, and the theoretical analysis is conducted, generating the conceptual framework and reflections of the empirical framework that discusses the related experiences and application of the study in other spheres. It starts by giving the working definition of the terms, the purpose, and forms of literature review in research. The theoretical framework and its components are discussed to highlight why existent theories are an important foundation for any new research studies. Specific theories namely; the Natural Resource Curse Theory, the DPSIR framework, and the Resource base View (RBV) are presented and discussed. The chapter also discusses the implications of the discussed theories to the current study. This research adopts Machi and Mcevoy's (2009), definition which states that a literature review consists of written notes that present a logically argued case founded on a comprehensive understanding of the current state of knowledge about a topic of study, in which case it establishes a convincing thesis aimed at answering the research study question. Literature review takes different forms that can be described as narrative, systematic, argumentative, and theoretical (Anfara and Mertz, 2006). This chapter discusses the literature review which involves the selection of appropriate theories in the field of mining and sustainable development and how they are related in terms of their postulation and predictions.

2.2. THEORETICAL FRAMEWORK

This will consist of existing theories that guide the research, (Osanloo, 2014). This study utilizes three theories: the DPSIR framework (Obudu, 2022). The Natural Resources Curse theory (Nguyen, 2021), and the sustainable development theory, (Safdie, 2024), to analyze and address the Artisanal and Small-scale Mining (ASGM) sector. These theories provide a comprehensive perspective on the interplay between driving forces, environmental pressures, social states, impacts, and responses. The DPSIR framework helps identify causal relationships and systemic interactions among factors influencing ASGM activities, while the Natural Resources Curse theory contextualizes socio-economic dynamics and potential risks associated with mineral resource exploitation (Michael, 2022). Sustainable development theory promotes holistic approaches to mining that prioritize ecological sustainability, social

sustainability, and economic sustainability (Younis, 2017). Integrating these theories allows researchers and policymakers to delve deeper into the root causes, complex dynamics, and potential solutions to challenges within the ASGM sector. This analytical depth informs evidence-based decision-making and enhances the relevance and effectiveness of policy interventions and management strategies aimed at promoting sustainable development in ASGM. By identifying key leverage points, trade-offs, and synergies across economic, social, and environmental dimensions, policymakers can design targeted policies that address vulnerabilities, enhance resilience, and maximize positive outcomes while minimizing negative impacts.

2.2.1 The Natural Resources Curse

There is an extensive body of theoretical and empirical literature on the role of mineral resources in economic development. The schools of thought are divided between those who argue that mineral resources are a curse and that, in general, growth in mineral-rich and dependent economies has been worse than in less endowed countries and scholars who consider mineral resources an endowment that has the potential to spur growth and development in developing countries, such as the gold produced by ASGM actors. Thus, this theory emphasises the Economic cause-and-effect relationship between ASGM activities and sustainable development, while tackling the first objective of this study.

2.2.1.1 The Natural Resource Curse: Socioeconomic & Governance Views on ASGM & Sustainable Development

Those who are not persuaded about the role of mining as a growth engine reason that most mining in developing countries is a capital-intensive enclave industry, foreign-owned, operated largely by expatriates, and uses inputs purchased abroad. Furthermore, in the local economic development setup, the success of the Golden Valley juxtaposed with the struggling ASGM operators, who operate in violent and crime-infested territories, suggests the prevalence of poor engagement of the ASGM stakeholders, and weak institutional engagements and absence of legal frameworks that optimally regulate, support, and enhance the sector, (The United Nations Interagency Framework Team for Preventive Action, 2012). At a continental scale, weighing the natural resources curse, the Sahel region consists of ten countries, namely, Senegal, Gambia, Mauritania, Guinea, Mali, Burkina Faso, Niger, Chad, Cameroon, and Nigeria, rich in vast petroleum, gold, and uranium. Niger, alone is the largest supplier of uranium, commanding some of the resources such as coal, gold, gypsum, and oil. Despite all such massive endowments, Niger is ranked 189 out of 191 countries on the United Nations Human Development Index, making it thus, one of the poorest countries in

the world, (Hassan Isilow, 2023). The paradox of rich minerals and poor health services, too distant schools, weak infrastructure, high unemployment, and poor sanitation conditions often characterize the countries endowed with rich minerals, (Tweneboah, 2024). In the absence of sustained mineral value chains, and the exportation of raw minerals from Africa, the continent's Governments, Regional blocs, and lately the African Continental Free Trade Agreement (ACFTA) need to foster concerted policies that promote maximum beneficiation of the mineral and all raw minerals to drive collective comparative advantages. The high prevalence of socioeconomic, environmental, and weak natural resources governance frameworks continue to render Africa vulnerable to a high influx of foreigners coming to plunder the resources as few people in governments benefit. Communities are deprived of any benefit in the form of development and potable water (Zero Carbon Analytics, 2024). The above synopsis concurs with the Natural Resources Curse theory that is underpinned by the insistence that Africa, home to the rich minerals has communities mired in poverty, is far from food sufficiency, decent housing, health care, jobs, sound infrastructure, and collective prosperity, (Arief, 2015).

2.2.2. DPSIR-Framework Supporting Sustainable Development

It is acknowledged that the contemporary problems of pollution, urban sprawl, environmental equity, environmental justice, and environmental management are complex and usually transcend spatial and temporal scales that are known and created by humans.

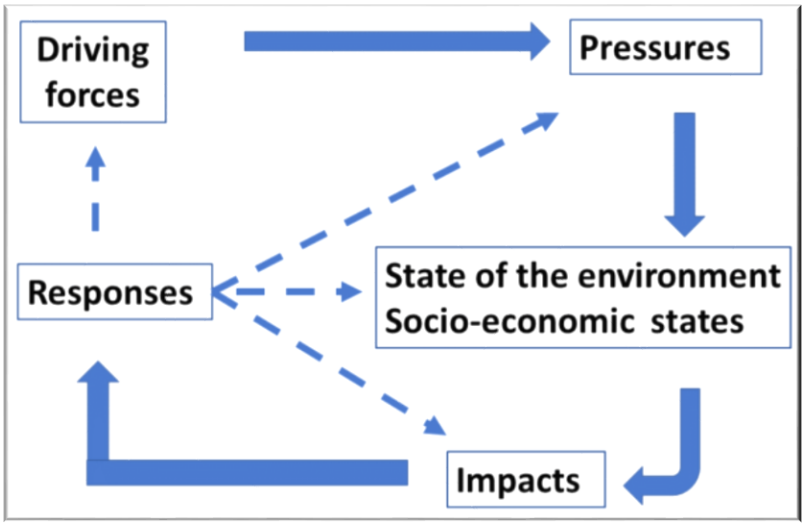


Figure 2. 1 (Gupta, 2020)

The DPSIR framework, which denotes Driving Forces, Pressures, States, Impacts, and Responses above illustrates the linkages between social, and environmental factors while juxtaposing the state of and impact on these ecosystems, not based on the current snapshot but throughout the time. Furthermore, scientific research and the accompanying decisions are oftentimes only focused on a particular and specific economic issue, together with its level of authority within the scientific area. As such, they would only address mostly that single identified aspect of the problem without adequate understanding consideration of the short and long-term consequences to the larger scope. Added to this, stakeholders and policy decision-makers would then be forced to formulate and implement several multiple, often uncoordinated management plans and actions. While it is acknowledged that each of these management plans and actions may be successfully implemented and achieve desired outcomes for a particular purpose, the combined effects may not lead to improved environmental conditions because of a lack of synergy and common purpose (OECD, 2015).

2.2.2.1. DPSIR Framework Structure

One supporting systems approach suitable for interrogating the gold production contribution towards sustainable development is the Driving Forces – Pressures – State – Impacts – Responses (DPSIR) framework, which has been a valuable tool for organizing and communicating complex environmental and developmental issues. The DPSIR framework was developed by the European Environmental Agency, has been used by the United Nations, and has been adopted by the US Environmental Protection Agency (EPA) in the Sustainable Puerto Rico initiative (Alejandra M, 2017). The DPSIR framework is a systems-thinking framework that assumes cause-effect relationships between interacting components of social, economic, and environmental systems.

2.2.2.2. Application of the DPSIR Framework

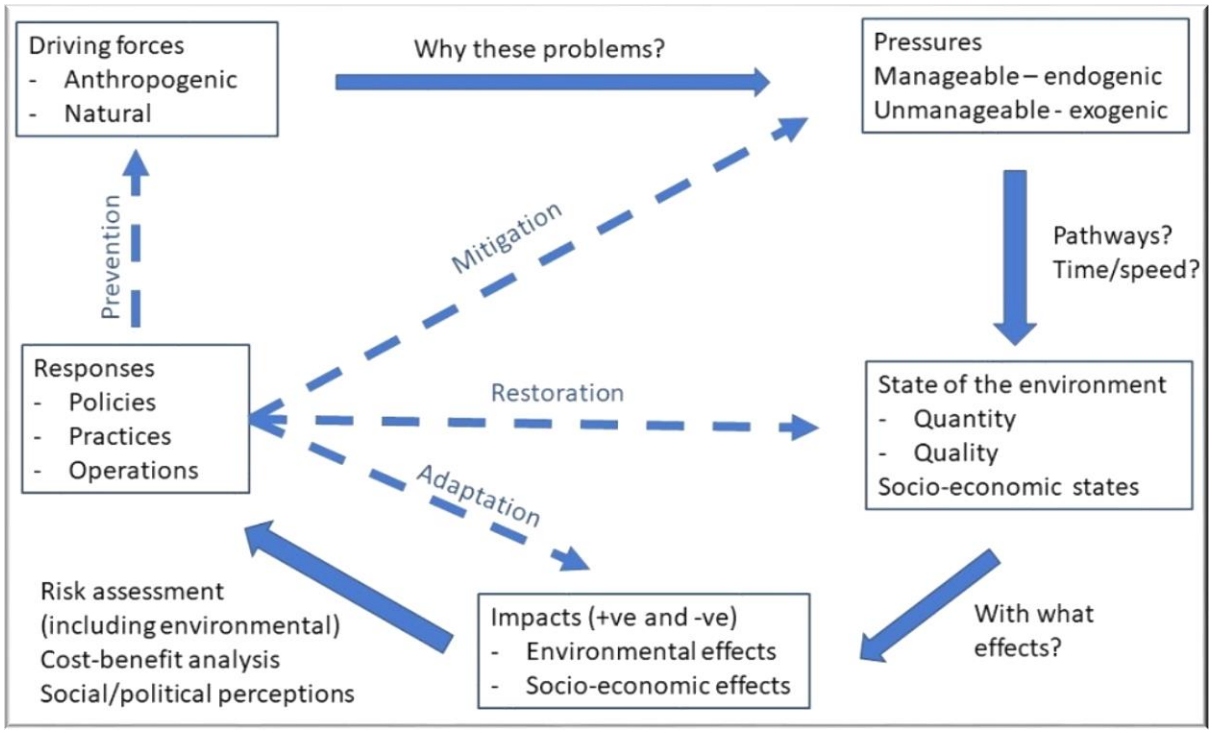


Figure 2. 2 Source (Allen, 2022)

The DPSIR framework has been used for many environmental resource applications, including the management of agricultural systems, water resources, land and soil resources, and biodiversity. The framework can also be used to integrate social, cultural, and economic aspects of environmental and human health into a single framework (Allen, 2022). DPSIR has most commonly been used in the context of environmental management to link ecological and socioeconomic factors.

2.2.2.2.1. Driving Forces

Driving Forces are the factors that motivate human activities and fulfil basic human needs, which have been consistently identified as the necessary conditions and materials for a good life, good health, good social relations, security, and freedom. The spatial distribution and intensity of Driving Forces vary - they can originate and impact globally, regionally, or locally. Driving Forces are not:

- Climate and weather influences (global climate change)–these are all part of the Environmental State.
- Any type of "management" (water management) – these are responses.
- Human population – this is reflected in the human state and is a result of Social Driving Forces.

Driving Forces describe “the social, demographic, and economic developments in societies” (United States Environmental Protection Agency, 2020). Many studies specifically refer to economic sectors as drivers, while social factors that influence the structure, characteristics, and functioning of economic sectors, are less frequently described. Social determinants also have a strong influence on human health (Healy, 2013). Therefore, for this framework, Driving Forces have been divided into two categories, Economic Sectors, and Social Driving Forces. Economic Driving Forces fulfill human needs for food and raw materials, water, culture, security, health, shelter, and infrastructure. Driving Forces may fall into more than one sector (food and culture). Ambivalent issues should be placed where they will be most relevant to a management issue. Sectors providing Food and Raw Materials include - mining and quarrying – coal mining, and mineral mining, (Climate Policy Watcher, 2022)

2.2.2.2.2 Pressures: The ASGM Strategies on Sustainable Development

Pressures are defined as human activities, derived from the functioning of Social and Economic Driving Forces that induce changes in the environment, or human behaviours that can influence human health. On the environmental side, identifying a particular activity as a Pressure implies a causal relationship between that activity and an environmental change. Environmental Pressures may include discharges of chemical, physical, or biological agents, land-use changes, and direct contact uses. The intensity of Environmental Pressures depends on the technology and extent of source activities and can vary across geographic regions and spatial scales, (Joyeeta, 2020). Human Behaviour is an additional class of Pressures that can influence human health independent of Environmental Pressures influence the physical condition of the environment. We specifically define Human Behaviours, exuded through occupational practices by the artisanal miners in Chakari, as with all Pressures, as human activities that can increase the chances of developing a disease, disability, or syndrome, (Gupta, Scholtens, & Perch, 2020).

2.2.2.2.3 State: ASGM-Sustainable Development Ecosystem

State refers to the state of the natural and built environment (the quantity and quality of physical, chemicals such as mercury used by artisanal miners, and biological components such as farmers’ cattle, and human systems (population level and individual attributes). Chemical and biological processes interact to affect different ecosystem components (chemicals, biological species) and incorporate community and population attributes, but the human condition also incorporates individual-level and sub-population-level attributes (Gupta & Scholtens, 2020).

2.2.2.2.4 Impacts: ASGM – The Environmental View

Changes in the quality and functioning of the ecosystem have an impact on the welfare of humans, including the production of ecosystem goods and services and ultimately, human well-being (Blaettler , 2019). The local community in all Wards in Chakari, especially Ward 14, may enquire from literature the impact of ASGM activities on the sustainable development of any negatively affected environmental, economic, and social features such as any extensive degradation of the environment by destroying the natural resources which the population was supposed to use.

2.2.2.2.5 Responses: ASGM Actions on Sustainable Development

A key benefit of using the DPSIR framework in the current research study was that it explicitly includes an Action or Response component that can be taken at any level of the causal network. In the DPSIR framework, Responses are actions taken by groups or individuals in society and government to prevent, compensate, ameliorate, or adapt to changes in the state of the environment; and to modify human behaviours that contribute to health risks, to directly modify health through medical treatments, or to compensate for social or economic impacts of the human condition on human well-being, (Joyeeta Gupta, 2020).

2.3. SUMMARY OF THE DPSIR FRAMEWORK, ITS DRAWBACK AND STRENGTHS

The DPSIR framework provides a flexible, well-defined conceptual model for organizing and communicating complex environmental issues and is very suitable to portray the circumstances found within Ward 14 of the Kadoma District. The drawback of the DPSIR approach is its implicit hierarchical formation of concepts in social, health, and environmental sciences identified in the generic framework is intended to identify potential places for interactions among multiple stakeholder perspectives and across scientific disciplines in the study. The strength of the DPSIR approach is that it is transparent and simple with five concepts that are readily understandable to both scientists and stakeholders. Furthermore, it enhances communication by simplifying the complex connections between humans and the environment. How it fosters a systems approach in its inherently human-centricity while appealing to the public and decision-makers as well as implying causal relationships among the various factors such as those being studied in the current study of the ASGM activities on sustainable development, (Karen Tscherning, Elsevier).

2.4 RESOURCE-BASED VIEW FRAMEWORK

Competitive advantage is gained through the utilisation of internal resources and capabilities. This informed this study to a large extent as it explores how artisanal small-scale gold mining sectors' capabilities scale in gold production and sustainable development.

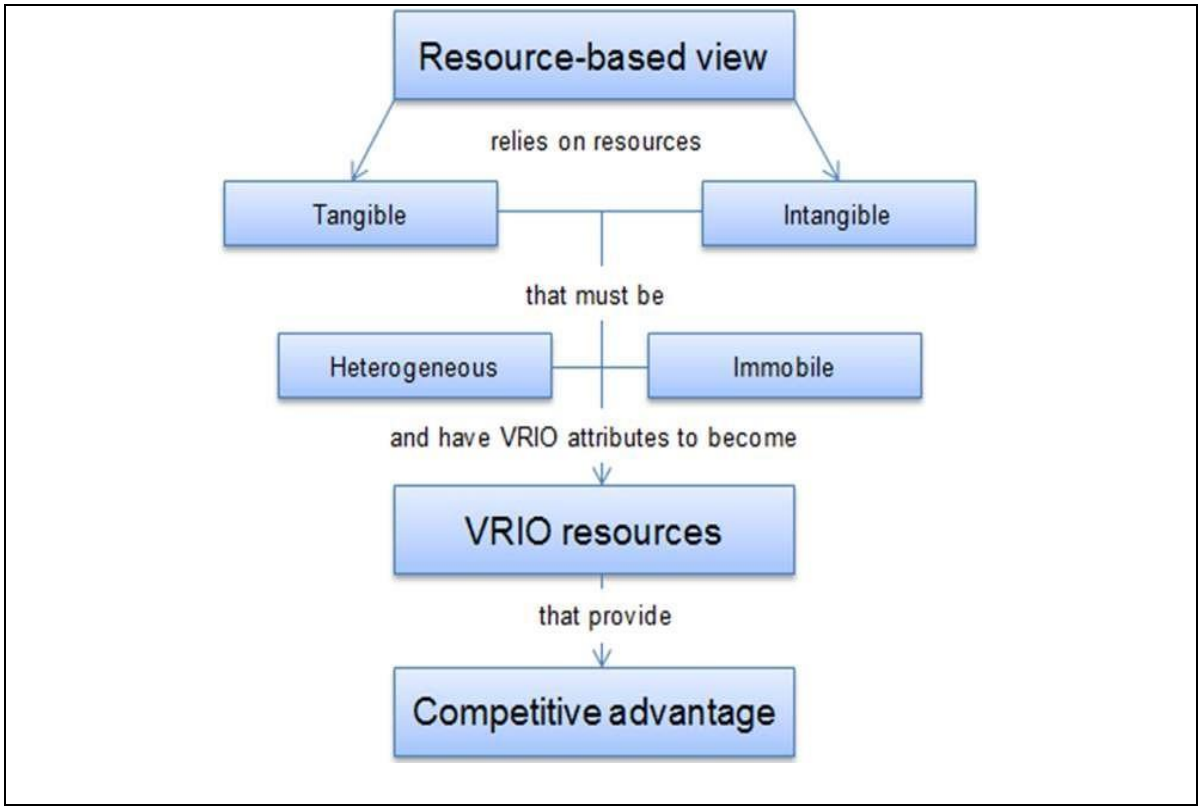


Figure 2. 3 Source: (Jurevicius, 2023)

The Resource Based View theory has been proffered in strategic management. The theory was conceptualized in pursuit of the need for companies to survive in competitive environments by focusing on the internal environment. Although the theory's thrusts are focused on the internal environment, it can be projected to provide an analysis of how economic sectors can thrive to play a part in the national growth and development arena. In this context, the RBV theory can enhance this study in its pursuit to interrogate the role that mineral beneficiation can play in the development of the small-scale mining sector in Zimbabwe.

The Resource-Based View (RBV) was propounded by Wernerfelt in 1984. In the RBV, the management of the company needs to identify internal resources that can be exploited to

gain a sustainable competitive advantage for the firm (Barnely, 1991). These resources can be either tangible or intangible. They are also described as heterogeneous and immobile. (Alcedo, Barrosso and Galan, 2006). These resources are complemented by how these resources are utilized in the production process (capabilities). The theory provides a key platform for and analysing the whole production process of the firm. Through resource identification, the company will be able to identify inputs for the production process. It also lays the ground for proper planning. Other scholars classify resources into financial, material, and human resources (Barney et al, 2007). These resources indicate the strengths and weaknesses of the company or sector. Various studies in the small-scale mining sector have so far pointed to the challenges besieging the sector in respect of the three resources identified by the RBV. The RBV has often been criticized for giving blanket propositions; modern scholars have gone further to suggest that firms might have resources and capabilities, but the management of those resources is also critical.

The RBV also discusses the need for firms to realise and take advantage of their internal capabilities. This refers to the knowledge systems within the firms that ensure efficient and effective use of the resources. This is responsible for the formation of the new concept of the Knowledge-Based View (KBV), which would address issues of motivation, innovation, and technology among other things.

Despite its cited weakness, the RBV sparks the study's interest as it seeks to assess the relevance of the artisanal small-scale gold mining contribution to sustainable development. The diagram in Fig 1 depicts the RBV framework and can help to illustrate the significance of the theory on the current study.

The availability of materials is critical in the determining the business. This relates to availability and abundance. Physical capital resources include raw materials, plant equipment, infrastructure, and location. Human resources within the organization include the level of training, employee experience and judgment, and insight, while organizational resources include the structure and the usual management functions of planning, controlling, and leading.

It is also important that the artisanal small-scale gold mining sector be assessed against the RBV predictions. Barney (1991) proposes four variables that can be used to assess the competitive suitability of a business. These are commonly referred to as the VRW attributes.

Value from the sector can be derived from two main areas. The first is that minerals are valuable as they have a ready market and have constant demand. Minerals such as gold and diamond are in demand. Secondly, as noted in the overview section, the small-scale mining ventures have come on board in terms of their contribution to mineral production. It can also be argued that, in some minerals, the ASGM has produced 100% of the total production, meaning the ASGM sector's value to the country's economy is on an upward trend. The artisanal small-scale mining sector exploits local deposits that are considered uneconomical by large-scale proponents. They create value from idle resources and they do not face competition. This creates a competitive advantage for the sector itself.

Wernerfelt (1984) identified forms of resources that businesses need to utilize to survive in the competitive environment. These are physical resources as described above, financial resources, human resources as well as organizational resources. All these resources are easy to identify in large-scale companies, that are formalized and they form critical success factors in company operations. The current study took the same format to gauge the issue of sustainable development adoption by the ASGM operators.

Informed by the RBV, the current study was determined to interrogate the capabilities of the artisanal small-scale gold mining sector to initiate and promote sustainable development. This can be possible by assessing the current status of sustainable development in the mining areas and also exploring the challenges and opportunities available for mineral output contribution towards sustainable development from the ASGM sector in Kadoma.

The study attempted to exhibit the artisanal small-scale gold mining advantage by enhancing its operations through opportunities created by its internal resources and capability. His study is mindful that the sustained competitive advantage of individual organizations can be measured through profits, market expansion, and contribution to GDP among others. The study explores the key performance indicators for sustainable development of the artisanal small-scale gold mining sector.

2.4.1. Implications and Criticisms of the Theories

In research, it is important to use theories to guide the scientific presentation of the study. As the research is comprised of various components that have to be clearly understood and analysed. They include the contexts and variables. Existing theories help to predict, explain, and understand phenomena (Saunders, Lewis, and Thornhill, 2016). From the researcher's point of view, the identified theories have been found to play a key role in the understanding of the domain of gold mining production in the artisanal small-scale gold mining sector against the expected sustainable development and its key concepts.

The notion that resource-rich countries are cursed remains a challenge and research can only provide solutions if resource-rich countries are to derive value from their minerals contrary to the predictions of the resource curse theory. However, the theory manages to provide a context for the field of study.

The RBV framework, the export base theory, and the value chain analysis attempt to give postulations on product value addition. The five-partite assessment framework as adopted in the study is the DPSIR (Driving force–Pressure–State–Impacts–Response) (EEA, 1999). Each indicator conveys its distinctive meaning and application.

Driving forces are social and economic factors and activities that cause either the increase or mitigation of pressures on the environment. Pressures or proximate causes are represented by direct anthropogenic pressures and impacts on the environment, such as pollutant emissions or the consumption of natural resources.

State relates to the current state and trends of the environment that determine the extent and magnitude of degradation. Impacts are the effects that environmental changes have on human and non-human health status. Responses are what the society perceives should be done, improved, or mitigated to realise a better environment (Pierce, 1998; EEA, 1999).

Despite the potential capabilities and the wide application of the DPSIR framework in the assessment of environmental problems and its potential to contribute to the formulation of environmental policies, its adoption is still at the infant stage in many developing countries, like Ghana. This is especially true in peripheral regions such as northern Ghana where there are pronounced human-driven, input-related, and accelerated environmental degradation problems that need to be assessed for an effective environmental decision-making process.

2.4.2. Reflection of the DPSIR Framework and Concluding Remarks

The DPSIR framework is an analytical framework that recognises the complexity of environmental interactions and provides a means of analysing them. Through the adoption of the DPSIR framework, the study was able to examine and quantify land cover changes in the area of study from 1990 to 2004. It was demonstrated that the area was covered with closed and open savannah woodland with dispersed grasses and much of it has been converted to the built-up and barren environment in the last 14 years.

Government economic policies especially in the industrial and mining sector, population growth and migration, loose frontier control allowing easy entry by Fulani herdsmen, poverty, and the existing land tenure system were identified as human-driven forces that led people to engage in activities that brought about environmental degradation (pressures). The adverse effects of the deteriorated state of the environment were observed by the research participants to include the direct physical impact of vegetative loss and indirect socio-economic and cultural impacts that include cross-cultural tensions, hardships on women, increased health risks, and declining living standards.

Even though responses on what should be done generated a lot of conflicting issues, most of the research participants agreed that the future of their natural heritage is being compromised just to improve the lives of others and wanted this to change. Therefore, it was suggested that human-driven forces, conversation practices, and impact mitigation measures be considered when formulating policies for environmental conservation in the area. The Ward 14 in Kadoma District has been extensively damaged, the local community has not benefited much from the exploitation of the gold and the key government departments such as EMA, MoMMD, and the RDC continue to run battles with the ASGM operators due to non-compliance some of which can be attributed to lack of competency, wilful disregard of any measures that draw out money from the pocket of the ASGM operators.

2.4.3. Smart Architecture

The primary value of smart architecture is to establish systems of basic relationships, interrelationships, influences, structure, behaviour, and more views of a system. Architecture is a formal construct and representation of a system in an environment, organized in a way that supports reasoning about the structures and behaviours of the system. Architecture consists of system components and the sub-systems developed, that will work together to implement the overall system in a coordinated and measured design. Furthermore,

architecture relays informational content of the elements consisting of a system, their relationship, and the rules governing those relationships, (Musukutwa, 2022; Wikipedia). The principle of good architecture is that meeting the needs of the stakeholders to their satisfaction does not violate established principles, (anonymous, 2006). Smart relates to sustainable and ecological-friendly while addressing urgent environmental concerns, resource-conserving strategies, use of green energy such as solar, rainfall harvesting, and safe occupational culture conscious of risk management systems, (ZIGURAT, 2024).

2.4.4 Gap in Theory

An important achievement emanating from an effective literature review is the location of an existing gap in the literature. The identified theories were able to offer key background knowledge and information about mining and sustainable development however some gaps were isolated and these were identified as given below.

Whilst some of their predictions may be true today, they are not conclusive as the contexts have evolved. Most of the theories were propounded by scholars in the developed world and their predictions may be different in the developing world where the current research was undertaken. Evident environmental dynamism can result in different conclusions and the discovery of new knowledge. The DPSIR framework which has been used as the anchorage theory for the study was initiated by the OECD in 1960, extensively used by the USEPA in America in the 1980s and some African countries such as Ghana and Nigeria successfully employed it in some rural areas but not in Southern Africa, Zimbabwe included. There is no research literature on sustainable development in the ASGM sector in Zimbabwe, where it seems the country has a major challenge to cause environmental degradation of a very high magnitude which can even lead to communities wanting to relocate and abandon their homes. There are different reasons why the small-scale gold mining sector carries itself in the manner it does and these determinants need to be identified and ultimately proffer a solution that results in increased competency and compliance by the ASGM operators.

2.5 CONCEPTUAL FRAMEWORK

According to Kumar (2018), a conceptual framework depicts key relationships between the main elements of research, such as the key factors, constructs, and variables. Therefore, a research conceptual framework for a study can be described as the system of concepts, assumptions, expectations, beliefs, and theories that support and inform the unwritten (Maxwell ed. 2005). A conceptual framework enables an appreciation of the network of ideas in the field of study. There is an element of constructs that exist in the mind of the

researcher. However, it is based on the knowledge and experiences of the researcher. The conceptual framework helps in organizing the study. Through the conceptual framework, the researcher would be able to shape the methodological decisions of the study. It helps to clarify, explain, and justify the research methodology factors that are selected for particular research, (Punch, 2005). A study has to have distinct variables these can be categorized into independent and dependent variables. The conceptual framework depicts the independent variable which is also presumed to have a cause on the dependent variable which is the presumed effect. According to Lathan (2005), the relationships are affected by mediating and moderating variables. All the variables and relationships are drawn from the theory and experience of the researcher.

The conceptual framework below in Figure 2 is employed for this study and shows the nexus between gold production and its contribution to sustainable development by the ASGM sector within the selected Ward 14 of Kadoma District. In this framework, gold production contribution is affected by five variables which include competency, compliance, challenges, local community support, government support, and enabling regulatory framework as well as improved governance of natural resources. The conceptual framework for this study is depicted in the following diagram.

The Conceptual Framework

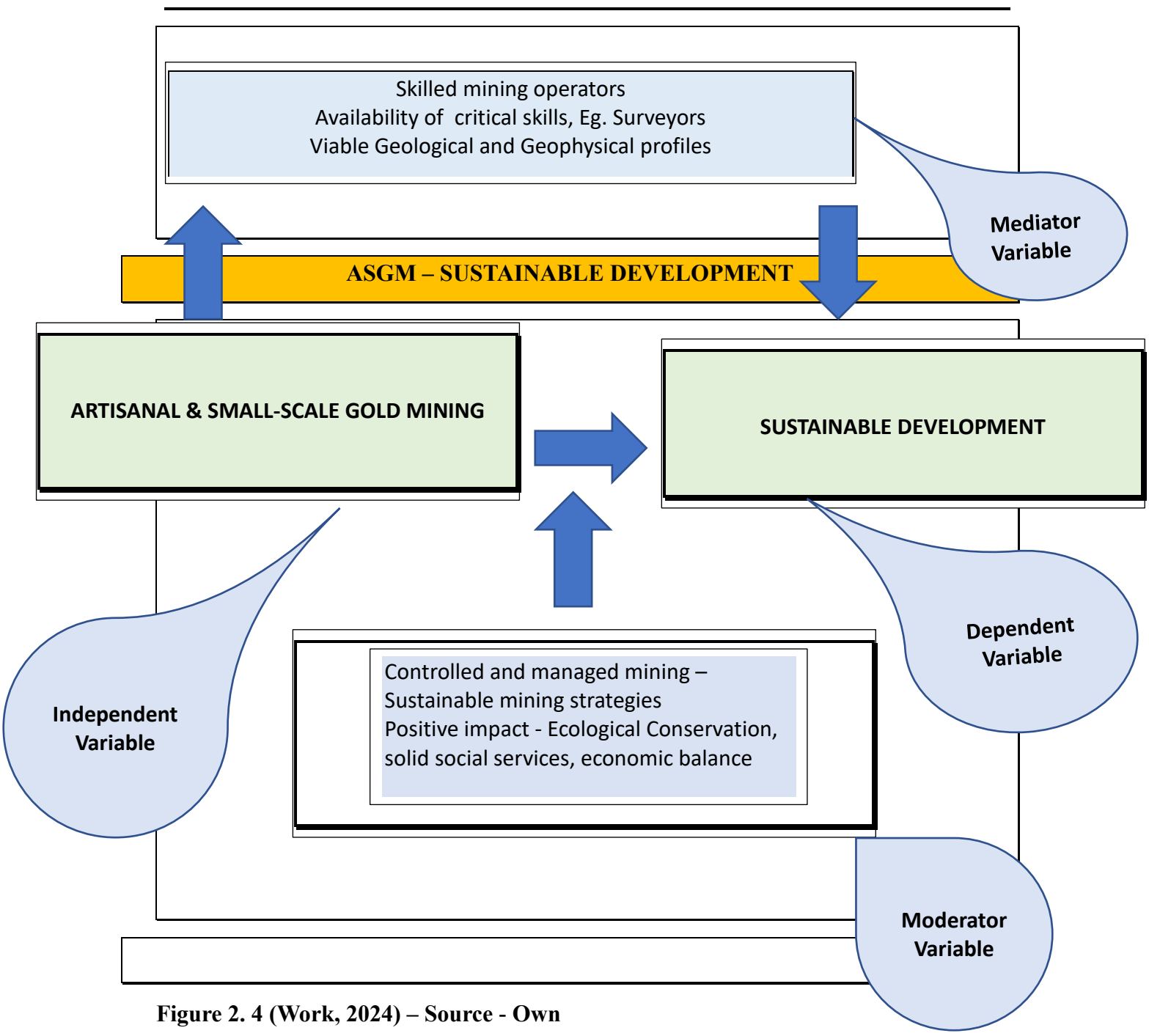


Figure 2. 4 (Work, 2024) – Source - Own

2.5.1. Conceptual Literature Analysis

In academic research, conceptual analysis plays an important role in explaining the meanings and relationships of ideas and concepts (Saunders et al, 2016). The conceptual literature review then facilitates comprehension and expansion of knowledge in the field of study as propounded by other scholars around the research study. Concepts are meanings of words and meanings that are expressed in the research topic or field. Carl and Dale (1997) posit that conceptual analysis is a process that starts by identifying the occurrence of

selected terms within a text. These terms or concepts are either explicit or implicit. In selecting the words, terms, and phrases, the researcher is mainly guided by the research questions. The explicit concepts that guide this study form part of the conceptual framework as research variables. Key research concepts for this study include sustainable development, environmental protection, social development, economic development, and contribution by the ASGM sector. There are also concepts within the intervening variables which include the external and internal factors that affect the relationship between the independent and the dependent variables. Implicit concepts discussed in the conceptual literature review are among others, local and sustainable development. These are notable as they speak to the context of the research.

2.5.2 The Policy and Legislative Framework on Mineral Processing in Zimbabwe

Aware of the declining performance of the economy and confronted with serious revenue challenges, high indebtedness, insufficient liquidities in the financial system, and decreasing confidence, the Zimbabwe government formed after the 2013 election set out to consolidate these reforms (Mlambo, 2015). Beneficiation was placed squarely at the centre of the formulation of this post-2013 economic policy and planning. Several policy documents lay testament to this and identify the specific objectives of the policy. To faithfully account for Zimbabwe's gold production policy, a brief assessment of the government policy initiatives was explored by analysing the formulation and initial implementation of the policy and investigating the factors underpinning the government's approach to implementing the strategy.

2.5.3 The Small-scale Mining Sector in Zimbabwe.

The consensus among various stakeholders is that there is no common definition of small-scale mining (Dreschler, 2001). From the various definitions that were put forward, there is a distinction between artisanal and small-scale miners. The criteria used to define characteristics of small-scale miners are among others, low production, low number of people in a productive unit limited employment of capital, low-quality reserves, and duration of the mining cycle (PACT, 2017). Using these characteristics, there are various definitions from different stakeholders. The United Nations perspective defines small-scale mining as a small operation that can produce unprocessed ore of 500,000 tonnes or less measured at the entrance of the mine (Dreschler, 2001). This definition comes from a comparative analysis of mining operations globally and it does not distinguish the context of the operation.

For instance, some operations that are considered big in developing countries would fall into the small operations category in developed countries. The UN definition is silent on the issue of mechanization which is critical in most developing countries including Zimbabwe. However, it gives a crucial idea of production capacity.

In Zimbabwe, the government through the Environmental Management Act defines, a small-scale miner as " a miner employing not more than 50 people including Government registered groups or syndicates or cooperatives, (Food and Agriculture Organisation , 2014).

2.5.4 Small-Scale Mining and Sustainable Development

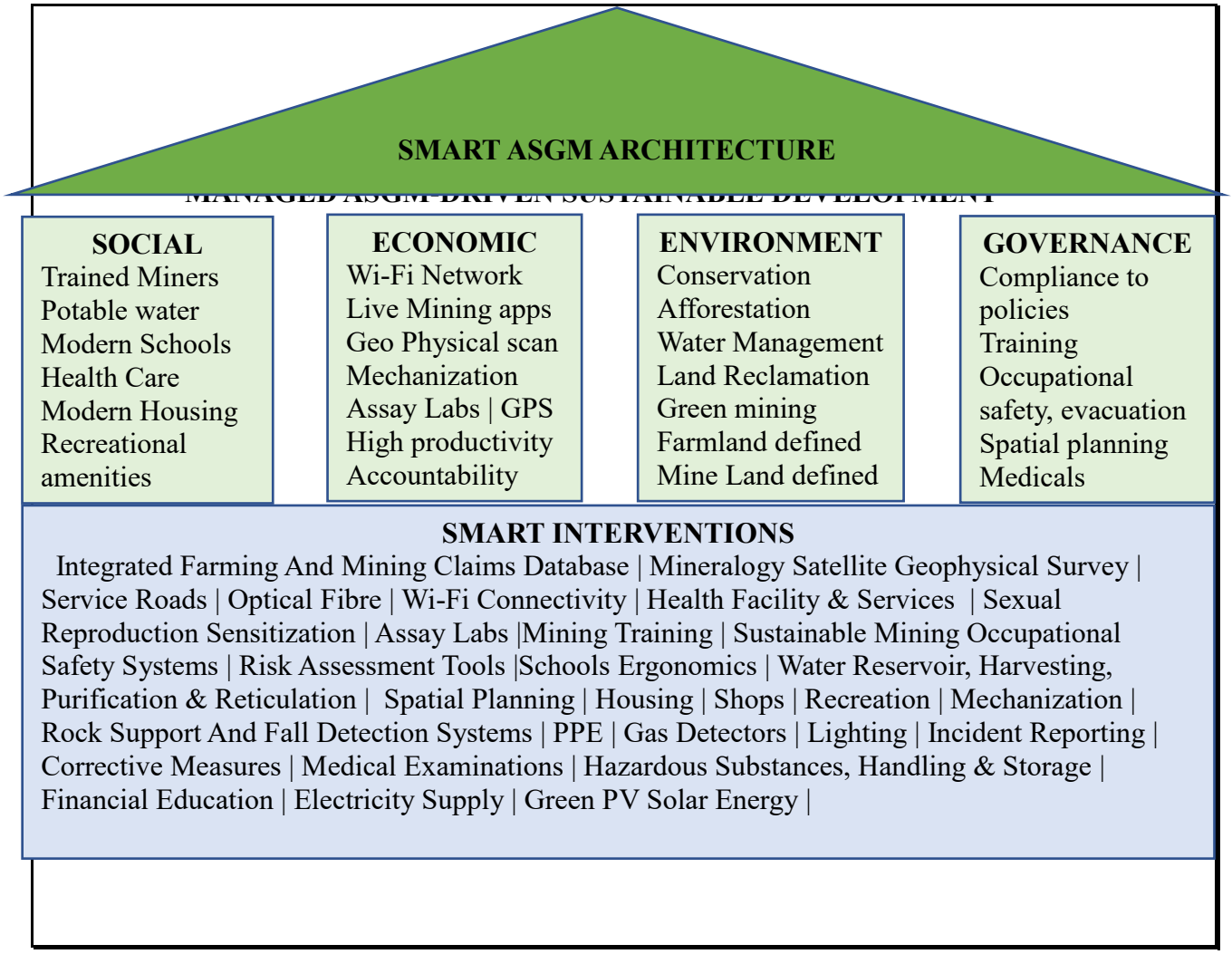


Figure 2. 5 (Source – Own work, Managed ASGM-Driven Sustainable Development, 2024)

The conceptual framework for the study denotes the sustainable development in the mining areas by artisanal small-scale gold mining as the dependent variable. It is therefore

important to understand the concepts of development from the perspective of other scholars. Growth and development are endeavours of all nations around the globe. Therefore, all economic activities aim to achieve growth of the company, stakeholders, and community at national and international levels. Sectorial development within economies can be understood within the context of sustainable development based on defined key performance indicators. Primarily, four indicators enable the assessment of the sustainability performance of economic activities, namely social, economic, environmental, and institutional indicators (Shields and Subba Rao, 2005).

Sustainable development can be defined as development that meets the needs of the present generation without compromising the needs of future generations to meet their own needs the World Commission on Environment and Development (WCED, 1987). The International Union for Conservation of Nature (IUCN) (1991) defined sustainable development as the upgrading of the quality of life of the communities within the carrying capacity of their surrounding ecosystems. There is a consensus that there should be a link between economic goals and environmental management goals. Businesses today are measured by their sustainable performance.

From a social perspective, sustainable performance can be measured by looking at the firms' contribution to social development. Employment is a key measurement performance of economic activity. It contributes to uplifting the livelihoods of locals, as people can get disposable incomes to meet their necessities. From formal employment, the government also benefits from revenue on pay as you earn (PAYE). This is not the case with small-scale enterprises. In Zimbabwe, formal employment declined because of economic challenges. The economy witnessed an increase in informal activities, (Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development , 2018)).

Economic activities increase disposable incomes among communities, and this has benefits as it leads to improvement in education, health, and food security Sustainability requires companies to align their organizational strategies (Hristov and Hirio, 2019).

Sustainable development can also be measured in terms of resultant growth in economic development. Sectorial contributions to economic performance are paramount. Economic sectors are expected to positively contribute to the gross domestic product (GDP) (Hentschel, Hruschka, and Priensten, 2003). Since the GDP variables include official

figures, only big companies are traditionally considered to contribute to the GDP because their figures are known. It can also be argued that informal business also contributes to the GDP because it employs a considerable portion of the population in Zimbabwe. In some instances, it has influenced the mushrooming of other formal economic activities as the study by PACT (2017) has revealed. Mberengwa rural service centre can be cited as an example of a pool of economic activities that have been attracted by a boom in small-scale mining. This has had an impact on consumption levels in an economy. Investment is also an economic measure as well as a GDP variable. It points to how sustainable the sector could be.

2.5.5. Small-Scale Mining and Local Development

Communities expect to benefit from economic activities taking place around them. In other developing countries some communities claim entailment or ownership of these resources especially when proponents are not from within the community (Svotwa, 1997). The entitlement is derived from the fact it is the community that is affected by the negative impacts of projects and therefore they should benefit from the profits from those projects. It is important to understand the role of the government in national resource distribution. The government is supposed to distribute national revenue to all its citizens fairly and equitably. Utilisation of this revenue would be expected to translate into the development of the country. Government-initiated projects would include infrastructure development and maintenance such as for schools, hospitals, roads, and electricity. In developing countries such as Zimbabwe, where there are fiscal challenges, the governments cannot adequately address infrastructural challenges to communities' expectations. Private companies are expected to complement government efforts on infrastructural development. Some governments can go to the extent of coming up with legal instruments. Through the Indigenous and Economic Empowerment Act Chapter 21:05, companies were expected to contribute to Community Share Ownership Trusts (CSOT). On the other hand, companies initiate community projects through their corporate social responsibility (CSR) portfolios. This comes from the realization that corporations need to give back to the community from which they are deriving their profits. It inculcates the spirit of core existence and social license. Through the provision of infrastructure, corporates play a role in improving the livelihoods of communities they operate from in terms of education and health care.

There has been a perspective that the artisanal small-scale mining actors have not been able to provide tangible benefits to communities. However, as discussed above, they contribute to the local livelihoods in several ways. First through the employment of locals. Secondly, most of the income from those activities is spent locally, thereby promoting local business. In some cases, businesses were opened to target small-scale mining around. Spending patterns for small-scale mines come as advantages to local businesses. It is therefore plausible to explore how the ASGM sector can be enhanced in terms of capacity and local development such as through the RDC.

2.5.6. Contribution of ASGM to Sustainable Development

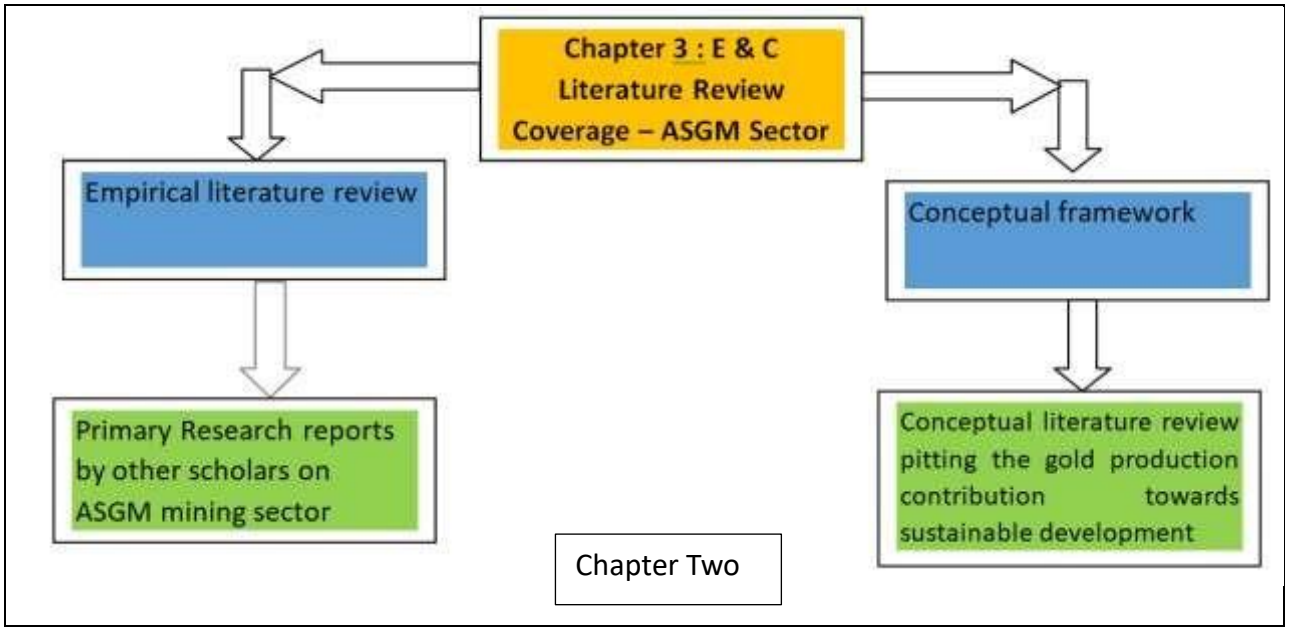
While it is difficult to define sustainability for an operation that exploits a non-renewable resource, Agenda 2000 and experiences from past and ongoing small-scale mining projects can help to define the desirable conditions of a sustainable small-scale mining sector. They should include ASGM activities should make a positive contribution to rural and regional development, Activities should operate legally in harmony with national mining sector development policies, and existing legal frameworks, Operations should comply with international social standards, such as social security, occupational health and safety, labour regulations (including ILO conventions about child labour), access to social infrastructure (schooling, medical), and an acceptable level of income, and Operations should be environmentally sound. Furthermore, there should be no conflict between small miners and local communities, there should be harmony between small and large mining operations, exploitation should concentrate on products with high recovery values and systematically develop these deposits, and there should be continuous operation over a longer period, (Thomas Hentschel F. H., 2003).

2.6. EMPIRICAL AND CONCEPTUAL LITERATURE REVIEW

2.6.1. Introduction

This Chapter discusses the empirical and conceptual literature review. It starts by focusing on the general terms in the empirical and conceptual framework. The empirical literature review section deliberates on empirical studies by UNCTAD (2017) on mineral trade policy in Indonesia and a study by Meyer and Meyer (2017) on small to medium enterprises in developing countries. From a continental perspective, the study by Jordan (1990) on the ASGM mining sector is also discussed. It includes a study by Alice Lungu (2014) on Small-scale mining in Sub-Saharan Africa.

The following section on the national view discusses articles on the scope of mining locally and the concept of mineral value addition by Dube (2016) and Majuru (2015) respectively. The conceptual literature review includes conceptual literature analysis and framework. The concepts of the study discussed in this section are gold mining production and factors affecting sustainable development by artisanal small-scale mining players, local development, and sustainable mining among others. The last section of the chapter looks at the implications and limitations of the empirical and conceptual review of the current study. The literature coverage in this chapter is reflected in the diagram given below.



Source: Scholar's Own Creation (2024)

Figure 2. 6: Illustrative Diagram of the approach adopted in Chapter 2

2.6.2. Definition of Key Terms

Gold production – it considers the quantity and amount of gold produced and sold from all the effort invested into the mining and production processes.

Gold production contribution – it is an important parameter that attempts to consider the gold production output which is used for the effecting of sustainable development activities, to balance the three pillars with the other two being environmental protection and social well-being of the people (Africa, I. o. S., 2018).

Sustainable development – it is a very important concept that tries to indicate what the country and organisation need to do to balance the three sustainable development pillars which are as follows (Davis, 2014):

- Economic development (in pursuit of profit)
- Environmental protection (in pursuit of the preservation of the earth)
- Social Development (in pursuit of people-oriented objectives)

Competency – this is an important feature of organisations and the management in which their capabilities are interrogated in terms of running the entity, making proper management decisions, and providing adequate leadership, resources, and employee training and motivation. Core competency is general to all players in the sector whilst distinctive competency is created through specialization and gives a competitive advantage to those who possess it (Spark Strategy, 2014).

Compliance – this refers to the organisation's ability to abide by the requirements that govern the sector in which it is doing its business; some of these requirements are statutory whilst others are not, such as the expectations of the community to local recruitment and employment of both youth and women (Spark Strategy, 2014).

Production challenges - this refers to the impediments that come in the way of the processing in which efficiencies, productivity, and effectiveness are ultimately compromised.

Some of these challenges can emanate from internal or external sources (Choshi, 2001).

2.6.3. Purpose Of Empirical Literature Review

For this study, the empirical literature review looks at studies that have been undertaken by other scholars in the field of small-scale mining and mineral beneficiation, particularly of gold and economic development. Anfara and Mertz (2006) explain that past studies review can assist the current study in several aspects. Firstly, empirical research helps to define the context of the current research topic. Second, as the study tries to identify past research it establishes some work that has been done around the topic and the researcher would be able to characterize the scope of the study. Third, the analysis of empirical research enabled the researcher to see the research methodology employed by past researchers and to be able to

choose the best methodology to come up with relevant and valid studies for the current study. Fourth, the literature review assisted the researcher in exploring key variables relevant to the study, and findings from the empirical literature were also informative to the current study as they could ride on the current findings. The findings helped in pointing to areas that need further research.

2.6.4. Empirical Literature Review

2.6.4.1. ASGM as Individual and Local Economic Enabler – An Analysis of Small and Medium Enterprises in Developing Countries

The success and failure of small and medium enterprises in which the ASGM fall into, have been among others attributed to how they are managed and run by their owners or the appointed managers. This has been seen as a huge factor influencing their contribution to their growth and their influence on national growth and sustainable development consideration. A Study by Meyer and Meyer (2017) entitled Management of Small and Medium Enterprises (SME) Development: An Analysis of Stumbling Blocks in a Developing Region" in 2017 sought to discuss management issues in the SME sector. The study aimed to identify and analyse challenges inhibiting the success of SMEs in South Africa within the context of the local environment (Meyer and Meyer, 2017). The study was motivated by the fact that globally, SMEs have been identified as key players in economic growth and development. As contented by scholars such as Gree and Thurnik (2003), SMEs can continue to play a significant role in global economies. The study was carried out in Gauteng Province in the Vaal-Triangle Region in South Africa. The region had diverse economic activities in the form of manufacturing, and agricultural sectors. The study was initiated against the background realisation that there was a low SME establishment rate (3.5%) in South Africa despite being one of the biggest African economies This may be attributed to the socio-economic history of the country where the environment was unfavourable for small businesses to thrive (Hilson, 2009). The study also informs that the SME sector also contributes to economic growth in developed nations like Italy (68%), France (58%), Netherlands (63%), and Germany (53%) while some developing countries like Egypt, Indonesia, and Turkey have SME contribution of over 50%. The research concern was that in South Africa there was a notable decline in SMEs' contribution to economic growth from around 45% in 2015 to around 35% in 2017 (Meyer and Meyer, 2017).

The study gives a variety of concepts discussed by various scholars about SME enterprises. The definition of SMEs is given from the South African perspective. They are defined in terms of the number of employees and annual turnover. The study findings tally with that of previous studies, particularly studies by Okpara and Wynn (2007) which found that SMEs contribute to economic growth in as much as large-scale enterprises and that there is a positive relationship between GDP and SME development.

The study identifies a theory by Schumpeter on New firm creation for Economic growth and Job Creation (Schumpeter, 1934). The theory submits that economic growth can only be driven through the creation of new firms such as SMEs. These new firms would bring innovation, new opportunities, new products, and services into the economy. New products and services would stimulate demand within the economy by fostering local spending, while expanded markets would increase disposable incomes through the employment of locals. In cases where raw materials for exports are produced, value addition can enhance export earnings. The study also draws from Schumpeter's 1942 concept of Creative Destruction" Through this concept firms go through stages to maturity as identified by Churchill and Lewis in 1983. Management was identified as a variable inherent in SME revolutionary stages that include establishment and existence, survival, success, take-off, and resource maturity (Meyer and Meyer, 2017).

Management factors that determine business success were identified as financial resources, quality human resources, system resources, and business resources (customers, suppliers, relationships, reputation, and technology). The study also identified major factors impacting SME development in South Africa, These are, lack of access to finance and credit resources, business management skills, poor infrastructure, low levels of research and development, restrictive labour laws and regulations: government policy, "red tape" and lack of coordination, crime and corruption, lack of access to markets (location) and market size, networking, production costs, and macro-economic impacts.

The study borrowed from the positivist philosophical approach through a quantitative research strategy. It employed a descriptive cross-sectional approach as its research design (Meyer and Meyer, 2017). Data was collected using a questionnaire that was self-administered by the participants with the assistance of research field workers. The IBM SPSS Version 25 was used for data analysis. This enabled the researcher to make statistical

analysis, descriptive analysis, factor analysis, and correlation analysis to present research findings.

The research established that several factors act as stumbling blocks to the growth of SMEs in South Africa. Through factor analysis, it was established that major factors were macroeconomic conditions, infrastructure, marketing and finance, management and skills, and environment. The study concludes that the creation of new businesses indeed contributes to economic growth in both developing and developed economies. It recommends that policy initiatives must focus on establishing and promoting SMEs through the removal of barriers to their growth and development.

The study provides an analysis of major challenges faced by small and medium enterprises in South Africa and indeed the whole of Africa within the context of economic growth and development. This cut across all sectors of the economy including the small-scale mining sector because the environments in which they operate were the same. The study gives the basis for an analysis of the implications of management of business operations for artisanal small-scale gold mining operators in Zimbabwe. The current study benefited from the methodology employed by Meyer and Meyer (2017) as it appears to be appropriate for cross-sectional research, especially the factor analysis approach. The context and approach of the research enriches the current study

2.6.5. The ASGM Sector in Africa Sub-Sahara

The context of small-scale mining in Africa can be understood from studies carried out by some scholars within the continent. Lungu (2014) in pursuance of a study on International Development published an article entitled “Formalization of Artisanal and Small-scale Mining in sub-Saharan Africa”. This was based on challenges and opportunities in the formalisation of small-scale miners. The focus was on Sub-Saharan Africa. Sub-Saharan Africa is quite a huge area to focus on. It is comprised of many countries with different characteristics in terms of socio-economic status. For instance, policies and legislation differ from one country to another. However, the common phenomenon is the existence of small-scale mining. This is common in countries such as Zimbabwe, Malawi, Mozambique, and Zambia.

The study notes that efforts have been made in several countries on the formalisation of artisanal miners, but most of them still operate outside the parameters of the legislation. Lungu then contends that the legislative and policy frameworks employed by the government in sub-Saharan Africa were not adequate in regulating the ASM sector hence the current scenario where players continue to remain outside formalization frameworks. The study sought to exhibit the deficiencies of the policy and legal framework, by highlighting key drives to illegal mining. However, as indicated earlier, sub-Saharan Africa comprises many countries with diverse geopolitics. This had implications for the findings and conclusions of the research.

Lungu introduces a model of segmentation of the mining sector. This assists in the understanding of the key proponents in the mining industry. As depicted in the figure on the mining sector, it is divided into large-scale mining. The LSM is widely supported by relevant stakeholders which are the government, financial sector, and local communities.

On the other hand, the small-scale mining sector is depicted as neglected and disorganized. It also consists of registered SSM miners and unregistered small-scale miners. The model of segmentation helps to give a picture of perceptions towards the small-scale mining sector. These perceptions may exhibit themselves in the development domain and this study interrogated mineral beneficiation. These perceptions illustrate the negativities associated with the small-scale miners that could cause a lack of focus on its development. For instance MMSD (2002) gives SSM characteristics as, exploitation of marginal deposits, lack of capital, poor access to markets, low standards of health and safety, and environmental degradation. The SSM is also described as engaged in quick enrichment activities. It can be argued that these negativities are indicative of the continued underdevelopment of small-scale mining as society has tended to concentrate on their negatives while ignoring the positives.

Secondary data was used for this study, for instance, data from MMSD, which focused on Southern Africa. The other studies by earlier scholars point to why the study was able to research such a big area. i.e. ASGM. The study also highlights social problems associated with ASGM namely cultural disturbances, food security, occupational safety, and health (Monks, 2005).

The study looks at the complexity of the registration and formalization of small-scale miners from mineral governance perspectives. Mutemeri and Peterson (2002) are of the view that laws and regulations are difficult for artisanal small-scale gold miners to comprehend. This view informed this study as well, on whether these challenges would manifest themselves in gold production.

The study concludes by acknowledging that artisanal and small-scale mining is a phenomenon that cannot be wished away despite negative perspectives associated with it such as environmental degradation and destructive conflicts. This is mainly due to its role in the livelihoods of people in Sub-Saharan Africa and it recommends that governments take steps to formalize and promote the artisanal small-scale mining.

In conclusion, the study recognizes the potential of the small-scale mining sector to contribute to economic and sustainable development just as this study attempts to complement this view by focusing on gold mining and production.

2.6.6. The Mining of Minerals in Zimbabwe

The empirical literature on mineral production and processing includes a study by Dube in 2016. The study is entitled "The Scope for Mineral Beneficiation of Mineral Resources in Zimbabwe: The Case of Chrome and Platinum". The study was carried out in the aftermath of the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET) policy which sought to promote economic development through clusters (ZIMASSET, 2013). One cluster focused on mineral production and the government instituted some policy measures intended to promote local mineral production. The study sought to explore mineral production challenges in the chrome and platinum sectors. It also sought to assess whether the general economic environment would be able to sustain mineral production. The study took a desktop approach for the collection of data (it used) a qualitative strategy. It relied on secondary data. The sources of data included published data from the Zimbabwe Statistical Agency (ZIMSTAT), the Chamber of Mines reports, and the government's policy documents. Creswell (2018) posits that the disadvantage of using secondary data only may result in the researcher not answering specific questions. It follows that most scholars recommend that secondary data be complemented by primary data to get specific information from research participants, who might be able to provide contemporary information in the field of study. Secondary data may suffer from disadvantages such as

bias, the time factor, document authenticity, and representativeness. On the other hand, if the literature is available, the research is easier and less costly.

The study established that chrome mining was mainly transformed into ferrochrome by a few scale players within the chrome smelting business. Notable is the fact that these players get their ore feeds from small-scale chrome miners along the great dyke where most chrome ore deposits are found. This study aimed to complement the study by Dube by assessing why small-scale miners are not participating in chrome smelting and what can be done to stimulate their participation. The study by Dube was therefore quite revealing to this study.

The study also established that the government came up with a blanket raw chrome export ban between 2011 and 2015 aimed at stimulating local chrome smelting. This can be linked to the study by the United Nations Conference on Trade and Development (UNCTAD) discussed above where the Indonesian government tried to employ export restrictions to promote local value addition. The failure of the policy to stimulate ferrochrome exports to a significant level saw the government reversing the barn due to its effect on the small-scale miners who were previously benefiting by either exporting or selling their raw chrome to those who had exporting licenses (Baissac et al, 2017). The policy thrust by the government was to improve export revenue and the issue of sustainable livelihoods of small-scale chrome miners through chrome smelting was not included in the policy considerations.

The study points out that the three platinum players were subsidiaries of South African companies these were Zimplats, Unki, and Mimosa. All these companies had access to mineral processing infrastructure in South Africa. This has largely resulted in resistance to local mineral processing by those companies. On the Government side, this raises suspicion of malpractices such as abusing transfer pricing modalities. According to the Chamber of Mines, two companies Zimplats and Unki had built smelters whilst Mimosa Mining Company had yet to put up the infrastructure (Chamber of Mines, 2017). In such a scenario, government policy would suffer because of the strategic objectives of the primary proponents. It is also instructive to note that there are no indigenous players in the platinum industry which can be the reason why the government had to use punitive measures to ensure that there is local mineral processing in the PGM industry. Thus, the study recommends the need for policy measures that eliminate mistrust between the government and PGM mining sector players.

The study recommended an overhaul of the government policy on mineral beneficiation. It also proposed that the government must recognize that the smelting capacity in the chrome sectors was still low and there is a need to promote investments in the chrome sector. This study investigates the view of miners on the participation of small-scale miners in the chrome smelting business through issues such as toll smelting and local investments in ferrochrome processing.

The study however proposes policy prescriptions for large-scale players even though chrome mining is host to many small-scale players who might be in dire need of repositioning to contribute to the country's mineral beneficiation efforts. Notwithstanding, the study provides a contextual springboard to the current study.

2.6.7. The Transformation of the ASGM Sector for Sustainable Development in Zimbabwe

Artisanal gold mining is slowly adopting technology formally used in medium to large size mines and developing it into innovative, specialized equipment tailored to conditions about remote locations in Zimbabwe. Artisanal miners use obsolete technology and are ill-informed of new transitions in terms of technical knowledge on sustainable development, mine planning, and design techniques due to rudiment mining principles still in use. Low productivity due to low efficiency in mining operations has undermined the economic potential of artisan gold miners. This economic potential has also been affected by rapid environmental degradation caused by artisan miners. The rationale of the study was to identify the appropriate smart architecture that can be a model for sustainable development for the ASGM sector. The prospective model design was environmentally friendly and promoted sustainability in the artisanal gold mining sector.

Rapid Rural Appraisal (RRA) method was used for collecting information for the identification and assessment of different methodologies in ore extraction and processing used by ASGMs; and the assessment of the level of awareness of safety, health, and environmental issues as part of sustainability. Logic modelling was applied to information concerning technology development and the environmental awareness of artisan gold miners. A sample of twenty-five artisan miners were interviewed at length. The average age of the workers was 27.4 years old with the majority of them being youth who are school leavers. There is a bias towards the use of unconventional technology as it is inexpensive and simple, 48% of the interviewed miners thought panning activities destroyed rivers and

76% were aware of mercury and cyanide poisoning effects. The amalgamation process (for gold extraction) poses great health risks to panners especially during the heating of the amalgam as this is done mostly indoors. This incipient equipment has less than 50% average recovery of free gold whilst a newly developed wind-sifting, gravity separator (that does not require water) can achieve 90% recovery of free gold. Transformation in the artisanal mining sector can be initiated by organizing miners into syndicates to equip them in large groups with appropriate tools and techniques to run their mines.

2.6.7.1. The Effective and Sustainable Management of Ghana's ASGM Sector

Over the years, ASGM activities have been associated with unacceptable mining practices, which pose several health and environmental risks to communities and nations at large. Ghana is currently confronted with pollution of its main water bodies, which has reduced the supply of good quality water to the populace. To address these problems, several attempts - policy formulation, formalisation, and introduction of technical assistance - have been undertaken by the government of Ghana and other international bodies such as the United Nations Industrial Development Organisation - UNIDO. Despite these attempts, the majority of artisanal small-scale miners are not registered and even some registered miners together with unregistered miners indulge in unacceptable mining practices. Premised on these, the study sought to undertake a thorough review of the challenges associated with the management of ASGM in Ghana and provide a framework for the effective management of the sector. Consequently, a three-pronged approach (problem analysis, planning implementation, and enforcement) with a cross-cutting focus on monitoring and evaluation was recommended. Some of the issues isolated from the studies in Ghana include the highlights given below:

- Artisanal small-scale mining (ASGM) activities are associated with unacceptable mining practices in many African countries.
- ASGM activities pose health and environmental risks to communities and individuals.
- Several approaches have been proposed to improve ASGM activities.
- Miners continuously indulge in unacceptable mining practices.
- A three-pronged approach for sustainable and safe ASGM practice is recommended.

Plate 2. 1 : (Institute For Social Research in Africa, 2020).



Picture Source: (Institute For Social Research in Africa, 2020)**.**

2.6.7.2. ASGM Activities: The Sustainable Development Way

Some literature sources often say that responsible artisanal and small-scale gold mining (ASGM) is a tool for sustainable development. What do we mean by that? First, the sector is large. An estimated 15-20 million people work in ASGM, compared to about one million in large-scale gold mining. Second, artisanal miners typically earn 70-80% of the global gold spot price, a rate higher than nearly any other commodity. This has the potential to inject money directly into communities, which comprise over 100 million people. Finally, ASGM often occurs in rural areas in developing countries where other economic opportunities are lacking, (Malgorzata Stylo, The Sustainable Golas Through the Lens of Responsible Artisanal and Small-scale Gold Mining, 2021).

2.6.7.3. ASGM's Potential to Advance Sustainable Development

Sustainable development needs to be well understood by all key stakeholders. The global community has presented its vision of what sustainable development looks like through the UN's Sustainable Development Goals (SDGs). These goals speak to improving health, the environment, gender equality, and education, and reducing poverty, pollution, and inequality in concrete ways by 2030.

The World Gold Council's report "Gold mining's contribution to the UN SDGs" focuses on large-scale mining, but also notes the potential for the positive contribution of ASGM to the SDGs and provides examples of the co-existence of large-scale and ASGM operators, (Gold Mining's Contribution to the UN Susyainable Development Goals , 2020).

Finally, the PlanetGOLD programme has also mapped 12 of the 17 SDGs to the ASGM sector, demonstrating the real—and often unrecognized—prospect for the deployment of socially responsible investing and impact investment, (Malgorzata Stylo, The Sustainable Development Goals Through the Lens of Responsible Artisanal and Small-scale Gold Mining, 2021).

In many developing countries, artisanal and small-scale mining (ASM) is largely a poverty-driven activity that plays an important economic role. It is estimated that in the order of 13 million people in about 30 countries are directly engaged in small-scale mining, a significant proportion of whom are women and children. A further 80 to 100 million people across the developing world could depend on small-scale mining for some aspects of their livelihoods. Small-scale mining can be extremely environmentally damaging and often has serious health and safety consequences for workers and surrounding communities. This is generally due to poor practices in mining and processing target minerals. Governments in many countries regard ASM as an illegal activity. The consequent lack of an adequate regulatory and policy framework can prevent the formalization of this sector. This, in turn, makes improvements in the livelihoods of miners and their dependent communities difficult to achieve, (Thomas Hentschel F. H., Artisanal and Small-scale Mining: Challenges and Opportunities, 2002).

Conflicts over access and land use can be a particular issue in areas where indigenous or tribal peoples have traditional land rights or land-use patterns. These and other problems commonly associated with ASM (such as child labour, access to health care, and education) present a major challenge to the government and regulatory authorities.

2.6.8. Recommended Policy Measures

To create straightforward, steady, smart, and Sustainable Development in the small-scale mining sector in a way that contributes to rural development in areas such as Kadoma District and to integrate the ASGM activities into the formal economy, governments need to develop a consistent policy for the sector. This policy should be based on four strategic pillars: poverty alleviation, a good business climate for the small-scale mining sector, sustainability, and stabilization of government revenues from the sector.

2.7. THE EMPIRICAL AND CONCEPTUAL LITERATURE REVIEW: THE KEY INSIGHTS

Empirical and conceptual literature has been sources of vast information and knowledge important to this study on gold production contribution towards sustainable development. Prior work has been able to bring insights into gold mining practices, small-scale mining, and development as fragmented concepts. For instance, mineral production is depicted in its scientific form. Its importance and role in economic development are discussed from the perspective of established economies and technologically advanced methods such as those by large companies. The empirical literature on mining in Zimbabwe is leaning towards the PGM sector which is being exploited by large companies. It is also apparent that there is a convergence of perception on small-scale mining locally, regionally, and globally. This has to do with its existence and its small contribution to economic growth, further than that, the small-scale mining sector is viewed as a source of environmental degradation and associated social ills. Literature also provides insights into challenges besetting small-scale mining, but it appears the literature overlooks sustainable development in the areas being mined.

2.7.1. The Conceptual Literature: From the Aerial View

As discussed in the conceptual analysis, the conceptual literature review enhances and expands knowledge of the concepts identified in the research expressed in the objectives research questions, and conceptual framework. Concepts, that were initially constructed by the researcher, are better understood from the perspectives of literature around them. Sustainable development in artisanal small-scale gold mining was described in diverse literature and this helped the researcher to synthesize their relationship as independent and dependent variables of the study. The mediating and moderating variables were also conceptualized through the analysis of the literature on the study. Key concepts like livelihoods and sustainability were also included in the conceptual literature review.

2.8 SUMMARY OF THE CHAPTER

Chapter two has served the role of proffering the theoretical propositions guiding the research discussed. The DPSIR, RBV, Smart Architecture, and the Natural Resource Curse theories were given as suitable theories to give predictions about the research context in the ASGM mining sector with a focus on the ASGM relation to sustainable development. The importance of theoretical literature in exploring existent theories was highlighted and the links to the current research topic were given. The additional content in this chapter dealt with the empirical and conceptual literature review whose purpose has been to present the

empirical literature related to sustainable development in a gold production environment has been discussed. Literature expressing views at the world level, and continental, regional, and local perspectives was identified to help shape the scope of this study. The research conceptual framework was presented as well and the related conceptual literature review discussed. The next chapter focuses on the research methodology and design.

CHAPTER THREE

METHODOLOGY

3.1. INTRODUCTION

The study was conducted in the Kadoma District, specifically in the Chakari mining area. Two major large-scale mines in Chakari, namely Golden Valley and Dalny Mine were the focus of the study. Chakari is 32km northwest of Kadoma Central Business District. The impact of the prevalent ASGM activities on agricultural activities and the general ecosystem was ferreted during data collection, in line with the research objectives. The research methodology, design, and sampling techniques which informed the study are discussed in this chapter.

3.2. THE RESEARCH PHILOSOPHY

The researcher's intuition and judgment are shaped by their research philosophy. This involves the study of being, which stems from philosophical assumptions categorized under ontology, epistemology, and axiology (Mauthner, 2020). Axiology, specifically, refers to the consideration of the researcher's values, norms, and beliefs—such as their perceptions of what is right, wrong, or good—when shaping the research or influencing their mental framework and assumptions (Tufail, 2015). Collectively, these branches of research philosophy influence the researcher's perspective. There are four main scientific research philosophies that form methods for transforming ideas into knowledge. Positivism focuses on objective and analytical scientific views, while interpretivism asserts that the social world must be studied and interpreted subjectively. Pragmatism, on the other hand, emphasizes that the choice of research philosophy should not be rigid but should depend on the research trajectory. A pragmatist approach allows researchers to move freely between positivism and interpretivism, depending on the research topic and direction (Pranas Zukauskas, J. V., 2017).

3.2.1. Pragmatism Philosophy

The Pragmatism paradigm concedes to existential single or multiple realities with an objective reality that can be subjected to objective reality, apart from human experience (Walsh, 2019). This philosophy has combinational characteristics associated with positivism and interpretivism paradigms. Positivism is linked to the observable reality that focuses on pure data and facts without human interpretation or bias. In epistemology, the positivist

position focuses on facts or regularities that are measurable, leading to credibility and meaningfulness in the numerical data that often adopt experimental or quasi-experimental research designs, (Husam Helmi Alharahsheh, 2020), (Jansen, 2023). In the context of the current study, positivism can open statistical tests to misinterpretation in the research. Additionally, generalizations based on the study may overlook individual intentions and actions, leading to misunderstanding. The use of quantitative research, in positivism is descriptive which may limit the researcher's ability to gain insights into critical issues (Pius, 2020).

The positivist ontology holds that there is a single and absolute and objective reality for any phenomenon or situation, regardless of the researcher's beliefs. Its epistemology further asserts that reality is the same for all people, who can interpret society through observation and measurement, characterized by deductivism, phenomenalism, and objectivity (Yingxin, 2021). However, this philosophy lacks ability to fully capture the diverse perspectives of ASGM miners, authorities, regulators, and various stakeholders.

3.2.2. Interpretivism

This paradigm evolved after immense criticism of positivism and its subjective tendency. Interpretivism tackles in-depth factors and variables in a particular context. It recognizes that human beings cannot be explored like objective phenomena, (Dudovskly, 2022). Thus, natural sciences and social sciences were distinguished as such. Interpretivism considers the time and circumstances leading to the development of different social realities, especially those that characterise those involved or affected by the activities of the ASGM. The paradigm enriches the insights, and knowledge derived from people's in-depth perspectives, and the meanings that people attach in the social context (Weber, 2011). This philosophy typically adopts the qualitative methodology with data collection methods of interviews, observations, and textual analysis which essentially explore complex social phenomena and perspectives of individuals, (Girardin, 2023). Understanding people's perspectives and lived experiences in this study on the ASGM activities by artisanal and small-scale miners, recognizing that knowledge can be generated by exploring people's viewpoints, hence the philosophy stands adequately as the appropriate one to derive the most out of participants during data collection exercise (Jansen, Research Philosophy and Paradigms, 2023). However, interpretivism philosophy can be considered to be open to the influence of the researcher's values and interpretations which cause bias. It will be conceded that while such

influence can be apparent, the researcher's views, worldview, and judgment will be inevitable and will be deployed to enrich the research, leveraging direct participation in the industry and experiences. The interviews with open-ended questions about their experiences, diverse perspectives, and coping strategies, as opposed to collecting numerical data, measuring, and calculating it in a positivist approach, (Jansen, Research Philosophy and paradigms, 2023).

3.3. RESEARCH APPROACH: SELECTING METHODOLOGICAL OPTION

This is a systematic and theoretical procedure and appropriateness thereof, used to approach research. The methodology is determined by the nature of the research and includes Qualitative research, Quantitative, and Mixed Methods, (Bhosale, 2023). This study will use the Qualitative methodology.

3.4. RESEARCH STRATEGY

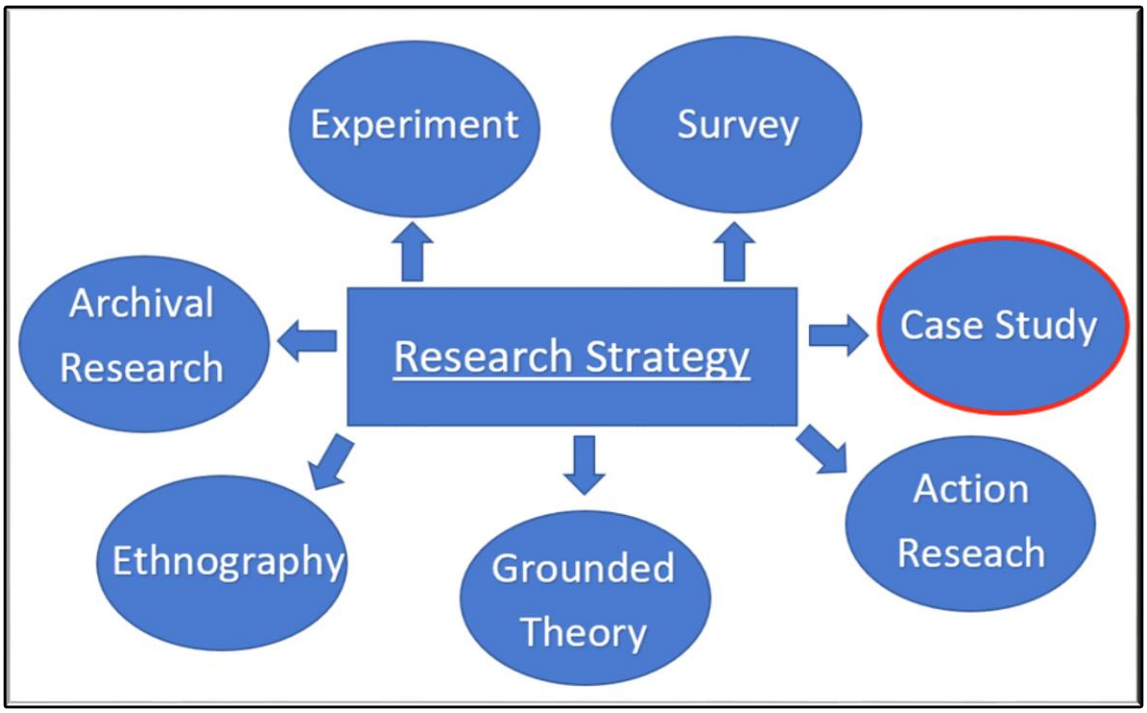


Figure 3. 1Adopted from (Talmatchi, 2020)

A research strategy is the general cardinal definition of research. It determines the general direction within the methodology and is determined by the research objectives and questions. Several methods and techniques including the case study, survey, experiment, grounded theory, ethnography, and cross-sectional studies, may all be convergent, and constitute the research strategy, depending on whether it is qualitative, quantitative, or mixed-methods, (CEOpedia, 2016).

Comprehending the motivation and the deep issue pertaining to the objective of the research is the key to understanding and generating the appropriate research strategy. Qualitative research entails research seeking a deep understanding of natural, human, and social phenomena derived from interviews, stories, and case studies, whereas quantitative provides scale as it deals with precise numbers, ratios, absolute values, and proportions analysed through statistical data, (Bamberger, 2020).

3.3.1. Deductive and Inductive Reasoning

This deductive approach is one with either absolute or quantifiable outcomes. This is related to quantitative studies. Alternately, inductive reasoning is evidential, premised on experiences, and beliefs, and infers probable true outcomes that are associated with qualitative study, (Smith N. , 2022).

3.4. RESEARCH DESIGN

This study aimed to develop a smart architecture for sustainable development to be used in ASGM activities. Thus, the efficacy of the research design is central to the success of that objective. It is an integrated plan that guides the research process. It gives direction and ensures that research objectives are satisfied, and results pass as reliable and valid. Research questions must be palatable to the objectives. Equally, the data collection, sampling, instruments, and analysis are discharged within acceptable ethical considerations before their presentation and reporting. Resources are key in the research process and need to ensure adequate resources before commencing the study, (Jain, 2023). The Research design consists of a descriptive, exploratory, case study, and explanatory, among others, (Sharma, 2024).

This research was qualitative in nature. A qualitative research method aims to understand beliefs, norms, experiences, and attitudes, (McLeod, 2023). This study followed the descriptive research design that assesses trends, characteristics, and categories, (McCombes, Descriptive Research, Definition, Types, Methods & Examples, 2023)

3.4.1. Ethnography

Some of the qualitative research approaches include Ethnography, a research design that has the researcher directly involved and immersed in the participants' environment in social and cultural anthropology. The research would view social phenomena that occurred during the research period which is advantageous in finding data that otherwise would have been

difficult to extract and record had it not been for the direct involvement and participation of the researcher in the research population, (Tenny, Brannan, & Brannan, Qualitative Study, 2022).

3.4.1.1. Narrative

Narrative research is a formidable characteristic of qualitative research in telling a story, thick detail, and rich description of the setting involved and quotes of the participants, (Tenny, Brannan, & Brannan, Qualitative Study, 2022).

3.4.1.2. Case Study

This focused on in-depth composite or multifaceted qualitative or quantitative research, (Iowa University, 2023).

3.4.1.3. Interviews

The interviews are performed in structured or semi-structured form and are rich in information that demands a set of skills on the part of the researcher in social skills, communication, extensive planning capacity, listening, and patience, (Knott, Rao, & Teeger, 2022). This would be the appropriate approach for this study in delving into the essential and experiential details of the ASGM sector while guarding all fissures for bias that can manifest through the following:

3.4.1.3.1. Hawthorne Effect

The Hawthorne effect asserts that participants change behaviour when they become aware that they are being watched or observed (Tenny, Brannan, & Brannan, Qualitative Study, 2022).

3.4.1.3.2. Observer-expectancy Effect

When participants unconsciously change behaviour to satisfy the interviewer, it becomes synonymous with the Pygmalion or Rosenthal effect (Barr, 2023).

3.4.1.3.3. Artificial Scenario Effect

The effect of preset goals emanates from artificial scenarios that in turn cause inaccurate information hence impairing the authenticity of data.

3.4.1.4. Survey

The survey approach is used in business research through the administration of questionnaires to the whole population and where empirical advice is required to make important decisions, (McCombes, Survey Research, 2023).

3.4.1.5. Action-oriented

The action-oriented approach is used internally in practical business research using theory and practice where recommendations for change would not be appropriate for this study. (OpenLearn, 2021).

3.5. TIME HORIZON

This study is based on the cross-sectional approach in its quest to establish the gold production contribution towards sustainable development within the Kadoma Mining District in the small-scale mining sector, (Thomas L. , 2020).

3.6. STUDY POPULATION AND SAMPLING

A research population, also called the target population, is the whole group that possesses specific characteristics and is of interest to the researcher, and the public, (Thomas R. , 2023). The study was conducted in Chakari in the Kadoma District. For this study, the population was the ASGM operators, the Ministry of Mines and Mining Development, the Rural District Council, and all other stakeholders.

The researcher had a total of two hundred research participants. Participants were classified predominantly by convenient sampling, with the exception of the ASGM operators which were classified through random sampling. Using purposive sampling, the researcher managed to identify participants who included government officials (McCombes, 2019). The majority of the study population for this study was artisanal small-scale miners operating in the Kadoma District, Zimbabwe.

3.6.1. Target Population

The researcher made efforts to get a list of all operating registered artisanal small-scale gold miners in the district from the Ministry of Mines and Mining Development. However, there was no formal record of the small-scale miners operating in Chakari. These miners were not enlisted with the Ministry of Mines and Mining Development in line with the provisions of

the law that require them to be registered, certified, and submit production and manpower returns. Creswell and Creswell (2017) opine that key informants play a key role in providing in-depth, exceptional, and professional knowledge on the study topic. This study identified informants from various institutions such as the Mining Associations, the Ministry of Mines and Mining Development, the Mineral Marketing Cooperation of Zimbabwe (MMCZ), and the Ward Councillors were included in the study as these were identified to be very helpful towards the endeavours of this research study.

3.6.2. Sampling Frames Employed in the Research

While the target population represents the general group of the concept being studied, the sampling frame is the specific list of the members of the population and how they can be contacted, (Frost, 2024). The significance of the sampling frame is underpinned by the correctness and completeness of the sample units and sample set respectively, (Ahmed, 2024). The sample frame included the ASGM operators, the Sanyati Rural District Council, Fidelity Printers and Refinery, NSSA, EMA, Ministry of Mines and Mineral Development, and the Zimbabwe Republic Police.

3.6.3. Sampling

3.6.3.1. Probability Sampling

The two basic categories of sampling usable in these kinds of research are probability sampling and non-probability sampling methods. Probability sampling involves random selection, which researchers can then make use of statistical inferences from a sample to a population. On the other hand, non-probability sampling involves non-random selection built on convenience or other criteria, allowing the researcher to easily gather primary data in natural settings (Cohen, 2000).

3.6.4. Non-Probability Sampling

Whilst pursuing the non-probability sampling methods, in selecting the actual research respondents, the study mostly relied on non-random methods. Small-scale miners are scattered all over the district and no sequence could be developed in carrying out the research using probability sampling. Data was collected from small-scale miners who were at milling centres and mine shafts and at the mining sites in the district. It made it convenient for the researcher to administer the questionnaire at the milling centres as these were easily accessible. The researcher also visited some small-scale mines in the district to collect information. In some cases, the researcher was directed to nearby small-scale mining operations where they also gathered data for the research.

The study collected data from key informants in the Ministry of Mines and Mining Development. The Ministry has a pivotal role in promoting, controlling, and regulating the mining sector as enshrined in the constitution of the country. Mining site rehabilitation is required in terms of the law. All the policies, legislation, and regulations in relation to mining affairs are under the purview of the Ministry of the Mines. EMA enforces the Environmental Management Act (Chapter 20:27, 2003). Through its various departments like Legal, Geological Survey, Mining Engineering, Metallurgy, and Mining promotions, the ministry executes its promotional, advisory, and regulatory functions for both large and small-scale mining sectors. It was considered prudent to enlist the Ministry of Mines as a source of information for this study under the key informant category. Participants were able to provide information on the government's perspective on ASGM activities and sustainable development in the ASGM mining sector. The study applied convenience sampling to identify respondents from the ministry.

The study also collected information from respondents from the Ministry of Environment and EMA. The Ministry has a central role in promoting environmental protection from all sectors of the economy.

3.6.5. Sample Size

Owing to limited time and financial budget, the research used a far smaller number of participants than in life experience. However, the researcher targeted to use the smallest sample size that gives the smallest magnification to the study outcomes and generalisations, (Webster, 2024). The data pertinent to sample size were extracted from the calculator while applying the saturation rule of the snowball theory discussed earlier on, (Konstantina Vasileiou, 2018). The sample for this study was calculated using a scientific calculator with an estimated population of two hundred ASGM Operators.

The study used a 95% confidence level and confidence interval of Step #6 with a population size of 200, to give a sample size of about 35 participants, (Alchemer, 2024). s. The table below illustrates the study's sampling strategy.

Table 3. 1 Research Outline of Sample and Sampling Strategies

The Sample Characteristics		The Sampling strategy	The Research Selected Instrument	The Target Participants
Zimbabwe Republic Police, National Social Security Authority		Purposive/ convenience	Interview	3
ASGM Operators		Convenience	Interview	37
Key informants	Ministry of Mines and Minerals Development; Liquid Intelligent Technologies, TelOne	Purposive Convenience	Interview	5
	EMA	Purposive Convenience	Interview	2
Fidelity Printers & Refinery (FPR)		Convenience	Interview	4
Total				51

Fig 8 Source: *Scholars Own Ideas (2024)*

- Purposive and Convenience sampling were selected
- Grounded Theory to be used during interviews – to be later explained in pages 64-65
- Representatives of regulators were also interviewed – ZRP, FPR, NSSA, EMA Representatives of broadband technology companies were also interviewed

3.6.6. Data Collection Methods

Data gathering is a process concerned with suitable ways of accumulating the research information around the research variables as identified earlier and this allowed the researcher to effectively answer research questions. The figure below attempts to highlight the data collection strategies, instruments, and means of processing.

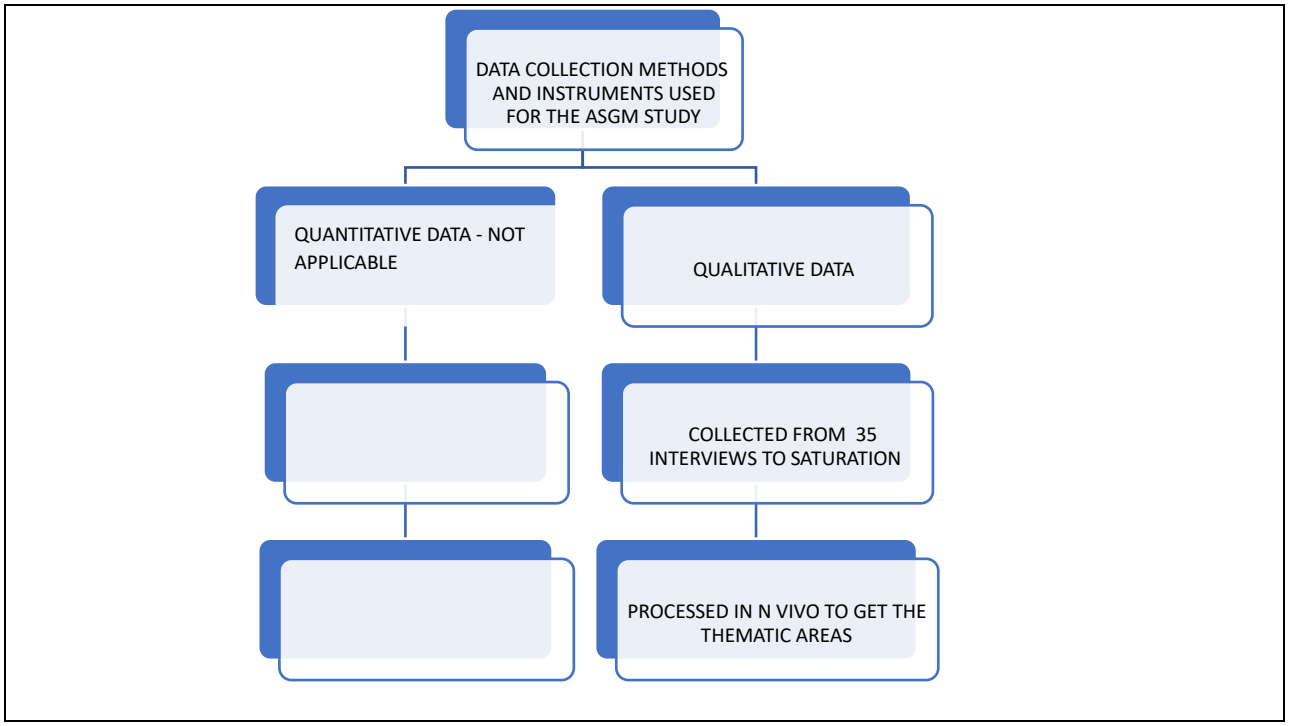


Figure 3. 2 Source: Own Creation (2024)

Data was collected and evaluated. Convincing and credible answers to research questions are determined by the quality of the gathered data which finally reflect the integrity of the whole research process, (Kabir, 2016).

Notably, through inductive reasoning, commencing from data collection to analysis, one data collection to analysis is Grounded Theory. Observation, focus groups, and interviews can use the grounded theory during data collection.

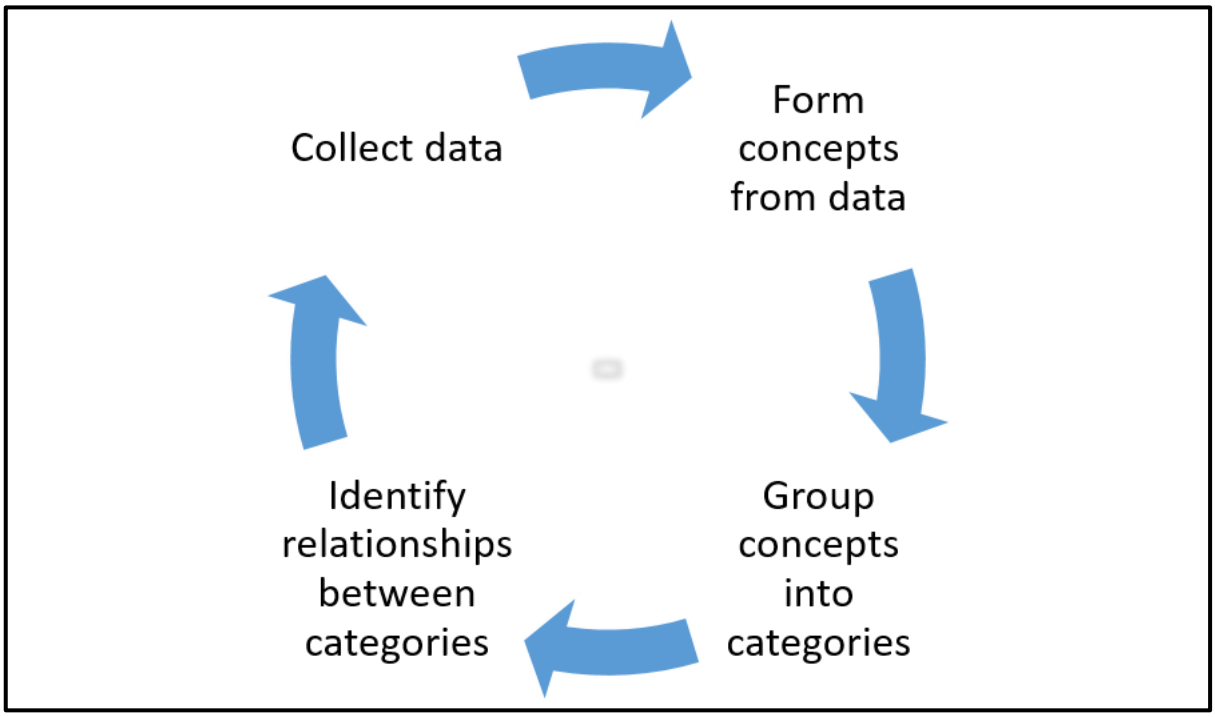


Figure 3. 3 (Deakin University, 2024)

The theory was used during data collection and analysis in an iterative, cyclical, and reflective methodology, with one informing the other, while influenced by the development and grouping of themes, categories, and concepts (Charmaz, 2007).

The interview method was used in research. I*t* is prudent for researchers to familiarise themselves with the concepts associated with the method to make appropriate choices in the data collection process. An interview can be described as a process of extracting information from a participant by asking questions and getting answers (Kabir, 2018). Cohen (2000) describes it as a social interaction between the researcher and the interviewer. In research, interviews are chosen because of their interactive nature. Interviews allow participants to explore deeper issues being discussed. For example, in politically charged environments, some issues that may be regarded as sensitive can then be explained and explored. Interviews imperatively create a good rapport between the interviewer and the interviewee and chances are that the participants would freely and honestly participate in the interview process, (Adhabi & Anozie, 2017). Cohen 2000, acknowledges that scholars such as Bogdan and Bicklen, (1992), Oppenheimer (1992), Kabir, (2018), and Klave (1996) have given varying types of interviews, but major differences rest with the structure of the interview, (Cohen, Phillips, & Palos, 2001). The study also utilised the interview method for collecting

data from informants from various institutions already mentioned above. An interview guide was used to gather information from the interviewees as illustrated in the appendix.

3.6.7. Reliability

Reliability generally concerns the replicability of research findings (Ritchie and Lewis, 2003). It is often evaluated through the consistency of the results of a research process (Blumberg et al., 2005). To ensure reliability for this study, the researcher established stability in the process of measurement by attempting to find indicators and avoiding subjective involvement in designing the questionnaire. Manipulation of results by any external factors was also avoided. External validity of this study was likely to be compromised by the selection of a non-random, purposive sample (officials from the identified institutions). There was no guarantee that the identified sample possessed similar knowledge and attitudes on smart architecture towards sustainable development within the Kadoma District. Hair *et a*l (2003) and Pallant (2007) state that the most common method for testing the internal consistency of a scale for reliability is the Cronbach Alpha coefficient. The Cronbach Alpha coefficient ranges from 0 to 1 with a minimum of 0.6, which suggests a high level of internal reliability. Reliability is, therefore, a test of the amount of consistency between the different measurements of an individual's response to make sure that these responses are consistent and similar over some time, and across situations. To enhance the reliability of the research instrument, a pilot study was conducted to determine the clarity of the items and consistency of the responses, within the Chakari Area of Kadoma away from Ward 14.

3.6.8. Validity

Creswell and Creswell (2017) state that a researcher must always pay attention to the issues of validity throughout the whole research process. Validity refers to the ability of the study to achieve its intended objectives. The effectiveness of the research instruments to gather the relevant data is key. The instrument must be connected to the topic, objectives, and questions of the study. The researchers must mitigate against the effects of construct validity, statistical conclusions validity, internal validity, and external validity. Construct validity can be ensured by checking how well the results correspond to established theories and other measures of the same concept. Statistical conclusion validity is the extent to which the conclusions drawn from a statistical test are accurate and reliable. To realise statistical validity, investigators must have an adequate sample size and choose the right statistical test to analyse the data. Internal validity denotes the degree of assurance that the causal

relationship being tested is reliable and not influenced by other factors or variables. External validity refers to the degree to which results from a research can be generalised to situations, groups, or events, applicable to a quantitative study and hence do not apply to this study.

3.6.9. Ethical Considerations and Procedures

The research observed the following principles for ethical research:

- The rights and dignity of individuals, and groups were also respected;
- Participants voluntarily participated, as they were appropriately informed;
- The research was conducted with integrity and transparency between the participants and the researcher;
- The research process respected the confidentiality and anonymity of the respondents
- Independence and impartiality of the research were also upheld, and maintained where conflicts of interest could not be avoided, these were made explicit**.**



Figure 3. 4 (Enago Academy, 2019)

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- The rights and dignity of individuals, and groups were also respected;
- Participants voluntarily participated, as they were appropriately informed;
- The research was conducted with integrity and transparency between the participants and the researcher;
- The research process respected the confidentiality and anonymity of the respondents
- Independence and impartiality of the research were also upheld, and maintained where conflicts of interest could not be avoided, these were made explicit.

One of the ethical requirements to data collection is that it is mandatory to secure requisite clearance from an unquestionable authority of the very entity, institution, and quasi-department before generating any research questions. Furthermore, the research questions should not seek to emotionally harm any prospective participant, while ensuring the confidentiality of the participants, providing latitude for withdrawal of any participant should they feel so (Simmi K. Ratan, 2019). One of the normally unexpected concerns relating to ethical issues is cultural sensitivity. Lindorff (2007) argues that the relationship between the researcher and the subject during an interview needs to be considered in terms of the values of the researcher and cultural aspects. Therefore, appropriate steps were taken to observe strict ethical guidelines to uphold participants' privacy, confidentiality, dignity, rights, and anonymity.

3.6.10 Data presentation, Analysis, Interpretation, and Discussion of Findings.

The choice of data analysis protocol is informed by the research objectives and research questions (Kumar, 2023). Babajide asserts that data analysis starts with the collection of data, and ensues with processing, breaking down the raw data into processed, logical, and interpretation. Data presentation requires skill to frame it in the form of visuals such as graphs, and pie charts among others, (Babajine, 2022).

Coding of the data in this study is a data analysis technique to enable the identification of related data, common themes, and categories that will be coded in the scope of the Grounded theory, (Illinois Library, 2024).

3.6.11 Purpose of Data Presentation

Once data collection was completed, the researcher immediately embarked on activities of editing and data profiling as Malhotra (2010) advises that the raw data or facts collected from the field need to be screened, presented, and then processed. The processing steps include data cleaning, editing, theme profiling, and tabulation (Iacobucci and Churchill, 2010; Synodinos, 2014).

3.6.12 Research Data Editing

The reason for editing is to guarantee that the collected data is complete and accurate and that it is aligned with the research objectives in line with Synodinos (2014) assertions that the data should be uniformly entered and organised simply to allow for coding as well as tabulating. The editing process was performed twice on the interview guide as recommended by (Creswell, 2018) who insists that the editing process must be performed before the data is captured for further processing. Furthermore, Zikmund and Babin (2013) note that editing

gives the assurance of checking the instrument for inherent errors (of omission or commission), illegibility, and inconsistency. To begin with, all questionnaires with incongruent responses and those falling outside the determined age bracket of 60 years of age and above, were discarded. In addition to that, and as Iqbal (2007) posits any feedback instrument that was less than 90% complete had to be discarded.

3.8. LIMITATION OF THE RESEARCH METHODOLOGY

The study had the following limitations:

- Accessibility to some small-scale gold mines in the Kadoma District due to bad roads
- Some miners did not want to accept that they were bona fide small-scale gold miners thinking they would be arrested.
- Bureaucratic red tape cooperation from government departments
- Lack of trust because of a politically charged environment.

3.9. SUMMARY OF CHAPTER

This chapter discussed the study's methodology. The research was premised on an interpretivism approach. It utilised both qualitative and quantitative strategies. Data was collected from participants who were purposively and conveniently selected. Semi-structured interviews were used to collect data from the respondents. The N-vivo analysis method was used for data analysis for the study. The next chapter presents the findings of the research.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF FINDINGS

4.1 INTRODUCTION

This fourth chapter of the research report presents and analyses the researcher's findings. The research results are presented with the outcome of each finding leading to analysis, discussion, and recommendations which are proffered in Chapter Five. The presentation takes the form of illustrations, pie charts, graphs, diagrams, and tables. The use of these presentation techniques is in line with Synodinos (2014) who states that the aim is to simplify the data for easy analysis, interpretation, and understanding. As Kitonga (2017) states, technological advancement has enabled researchers to collect huge amounts of data to process and analyse with ease.

4.1.1. The Interviews Response Summary

Of the 77 targeted participants from the ASGM operators, concerned Government Ministries, Departments, agencies, and key stakeholders requested to participate, eight withdrew in the middle of the interviews, while ten showed signs of restlessness and timidity, to some severe intoxication despite the morning interview slots. Thus, that translated into 69 that attempted the interviews, a total of 51 were effectively participated, resulting in a response rate achievement of 74.0%. This response rate is reliable; therefore, it allowed the researcher to analyse the data given that the rate concurs above the stipulated minimum by Sekeran and Bougie (2015) who pointed out that a response rate of 70% and over is excellent. The response rate is analysed in the table below.

Table 4. 1: Case Processing Summary

Cases	Total	%	Valid	Cumulative %
Valid	51	74.0	74.0	74.0
Premature exit	8	12.0	12.0	86.0
Unstable conduct	10	14.0	14.0	100.0
Administered	69	100.0	100.0	

Source: Primary Data, (2024)

A high response rate is necessary to yield reliable and valid responses out of the data collection process. Punch (2005) says that such a response rate increases confidence in the results as well as giving high credibility to the findings.

4.1.2. Saturation Level for the Interviews

During the qualitative data collection exercise in which the interview guide was used, interviews were carried out with the local leadership, senior staff from the government departments such as EMA, Fidelity Printers & Refinery, Ministry of Mines and Mining Development, Liquid Intelligent Technologies, and the ASGM operators.

interviews were conducted in order to ascertain that there was no more new information that was being received from the interviewees, and the process was stopped after all relevant questions had been asked and responded to and also after notes were taken from the interview process.

Kumar (2018) maintains that the saturation point in grounded theory must be the stage at which more interviews are no longer yielding any new data for the research.

4.1.3. Respondent Demographic Characteristics

In terms of the presentation of the sample demographic variables for the respondents' characteristics, Leedy and Ormrod (2010) show that these vary widely and this part presents these characteristics. Respondents' general information included primary dimensions of age, gender, origin, and experience. The researcher selected and presented in this section those attributes interrogated by the interview guide instrument that helps to establish the manner and level of understanding of the ASGM activities and their effects on sustainable development within the Wards 14 -16, also known as Chakari of Kadoma District. Table 2 below gives the essential details as obtained from the demographic data.

Table 4. 2 Demographic Trends Matrix

		Frequency	Percent	Valid Percent	Cumulative Percent
Gender of respondent	Female	19	37.8	37.8	37.8
	Male	32	62.2	62.2	100.0
	Total	51	100.0	100.0	
	ASGM Operators	40	45.9	45.9	83.8
	EMA, FPR, MoMMD	11	16.3	16.3	100.0
	Total	51	100.0	100.0	
Place of origin	Kadoma District	34	67.6	67.6	67.6
	Other Districts	17	32.4	32.4	100.0
	Total	51	100	100.0	
Years working in the ASGM sector	5-10 years	7	13.5	13.5	13.5
	11-15 years	23	45.9	45.9	59.5
	16-20 years	15	29.7	29.7	89.2
	More than 20 years	6	10.8	10.8	100.0
	Total	51	100.0	100.0	
age category	Less than 20 years	6	10.8	10.8	10.8
	20 -30 years	14	27.0	27.0	37.8
	31- 40 years	12	24.3	24.3	62.2
	41 - 50 years	11	21.6	21.6	83.8
	More than 50 years	8	16.2	16.2	100.0
	Total	51	100.0	100.0	

Source: Demographics Primary Data, (2024)

Gender of respondents: In terms of the gender of respondents within the final sample, 37.8% were females while 62.2% were males. These results indicate that the ASGM sector in the Kadoma District in Chakari is populated more by male folk than by women. Traditionally, the patriarchal system meant that men fended for their families whilst the

females stayed at home to tend to the children and other household chores. The emergence of women in the sector was attested to as a new trend.

Place of origin of the respondent: It is an important attribute since it can give a reflection of one's commitment to developing the area or not. The majority of the respondents making up 67.6% were from Kadoma District itself whilst the remaining 32.4% were from other Districts from Zimbabwe such as Mutoko, Kwekwe, Guruve, Gokwe, and Binga. These results indicate that the majority of the respondents are likely to be committed to working responsibly given that they are locals who are getting wealth whilst they are in their places of origin, though they seemed to have little to no education on the requisite strategies and systems for responsible mining. However, it would seem that the locals are likely to want to practise sustainable mining and invest back into the local community of which their parents and relatives are a part of mainly due to their recognizability to the traditional leadership and the Wards Councillor. Land degradation caused by mining activities as well as the required rehabilitation would be well within reach if we are dealing with the local area citizens.

Years working in the ASGM sector: Regarding Working Experience, 13.5% had 5-10 years, the majority of 45.9% had 11-15 years, 29.7% had 16-20 years while the remainder of 10.8% had More than 20 years. These results indicate that as many as 85% had spent at least 11 years working in the ASGM sector which placed them in a position to fully know the operations of the sector, such as the levels of gold produced, contribution towards sustainable development, specifically knowing the need for the rehabilitation of the degraded land, halting the extensive cutting down of trees, ploughing back into the community through social responsibility, payments of royalties to the Sanyati Rural District Council as well as complying with the legal requirements. Some good years of experience in a specific sector can assist in sharpening the operators in the essential skills and building the necessary competency.

Age category: Regarding the age category of the respondents, less than 20 years accounted for 10.8% of the sample, 20 -30 years age category had 27.0% which is the majority, 31- 40 years had 24.3%, 41 - 50 years had 21.6% while respondents with more than 50 years were 16.2%. These results indicate that the 20 to 50 years age group dominated the ASGM owners, managers, and employees, based on this one can safely

say mature men and women who understood the local culture, language, and customs as well as the importance of grazing land, value of trees and safety of children and animals roaming in the area.

Table 4. 3. Coding the Responses Using Grounded Theory

OPEN CODING	AXIAL CODING	SELECTIVE THEMES
1. Contributions to the local sustainable development agenda 2. Improve on the health and safety performance 3. Invest in sustainable development 4. Understand the expectations in terms of the sustainable development agenda 5. Employing more local youths and rewarding them appropriately 6. Illegal access to the gold 7. Efficient methods 8. Things related to the area 9. Better mining methods 10. Not rehabilitate the degraded areas 11. Lacked capitalization 12. Deposits far away from the surface 13. Attend any workshops 14. Undertaking short period workshops 15. Organized effectively 16. Productivity enhancements	1. Economic contribution 2. Environmental contribution 3. Challenges 4. Strategies 5. Productivity 6. Infrastructure development 7. Digital/ Smart Mining applications/ Communication	1. Economic contribution 2. Environmental contribution 3. Social contribution 4. Governance 5. Challenges

17. Good grades gold ores 18. Corporate social responsibility 19. High value gold 20. RDC royalties 21. Infrastructure development 22. Digital Broadband connectivity 23. Modern application to determine mineralogy, rock type/ hardness, and underground profile		

Coding Source: Primary Data (2024)

The analysis in open coding had 23, axial coding 7, and finally four main themes. Respondents view small-scale gold mining in Kadoma District in their contexts to be having economic, environmental, and social effects, and challenging remedies.

4.1.4. Feedback from the key Informant interviews

Key informant interviews were included in the questionnaire to get several viewpoints. The data were analysed through transcribing, reduction, and coding as suggested by Creswell (2018).

Table 4. 4 Key Informant Interviews

OPEN CODING	AXIAL CODES	SELECTIVE THEMES
1. No contribution by ASSM operators 2. Low local employment 3. No support to local causes 4. fees payable by miners 5. employing locals 6. Poor roads 7. Reclamation of Pits and gullies 8. budget for rehabilitation 9. Repatriation of generated income 10. Location of the workshops 11. workshops not focused on the ASSM 12. Nonattendance to workshops 13. meetings by the SSM association 14. disseminate information on legislation 15. violence by illegal miners 16. small unregistered claims 17. holding cash 18. machete wars 19. good citizenry 20. Dialogue with all key stakeholders 21. proper communication 22. empowering Women and Youth 23. creation a Ministry of ASSM 24. access governmental funds 25. Improve government gold prices	1 Economic contribution 2 Environmental degradation 3 Equipping owners of small-scale mines 4 challenges 5 Strategies to improve sustainable use of gold 6 Employee productivity 7 Production efficiency	1. Economic 2. contribution 3. Environmental degradation 4. Challenges 5. Strategies to improve sustainable use of gold 6. Governance systems that are upright and corruption-proof

26. Provision of PPE 27. hazard identification and mitigation 28. Low-cost training 29. Conferences and workshops 30. procedures or policies		
31. homemade tools 32. Seconding MoM and EMA officials 33. understand requirements 34. inappropriate mining equipment 35. CSR programs 36. management measures 37. proper planning and controls 38. Budgetary control		

Feedback Source: Primary Data (2024)

The analysis in open coding revealed about 40 items, axial coding identified 9, and finally six main themes. Key informant interviews highlighted small-scale gold mining in Kadoma District as contributing to economic growth, environmental degradation, and associated challenges, strategies to improve sustainable use of gold, and the need for strategies to enhance productivity. The ASGM sector is viewed as strategic to the nation and the government, recognising this, has set a target of USD12 billion as the expected contribution to the national treasury. Zimbabwe has signed the seventeen Sustainable Development Goals under the United Nations Environment Programme, UNICEF, and WHO. The aim is to pursue economic activities such as mining that while also enhancing the other pillars of sustainable development which are environmental protection and social development. Other factors as shown in the table above, represent data based on the key themes. One of the greatest needs is to determine the best strategies to enhance sustainable development in all areas. MPRA (2020) insists that the future of humanity now largely depends on our actions to limit excesses in extracting and consuming earth's resources, with a clear understanding that the planet has boundaries to its capacity for regeneration.

The views indicate that ASGM activities have had a direct impact on livelihoods and social welfare within the study area of Kadoma District Wards 14-16. However, most of the ASGM operators believe that they are not responsible for reclaiming degraded areas, suggesting it is the role of government and local authorities. While the sector acknowledges that its mining practices contribute to ecologically harmful, unsustainable, and illegal environmental degradation, operators appear unwilling to participate e in reclamation efforts.

ASGM is also regarded as largely unregulated, particularly in terms of health, safety requirements, and environmental rehabilitation procedures. Even though small-scale gold mining can be licensed by the authorities, this is not the case in Chakari, Kadoma. The ASGM operators confirmed that their activities support the livelihoods of their dependents despite the tough conditions and hard labour. At the same time, respondents also pointed out the negative effects of mining on their well-being. These included increased prevalence of diseases, “machete” wars, the destruction of farmlands, pollution of water bodies, the prevalence of commercial sex workers in the area, the spread of sexually transmitted diseases, and pollution of air through blasting of explosives, which were being transported without any documentation and operated by untrained ASGM operators.

4.2. OBJECTIVES REVISITED

4.2.1. Implications for Policy/ Governance Intervention and Action

Whilst the government has shown a heavy-handedness to the ASGM sector, the scholar is of the view that this may not be the best way to deal with the sector and the operators since they are real economic actors. Now, considering the consequential impacts and effects of the ASGM activities, two response strategic categorical measures seem to be imperative as shown in the schema given below.

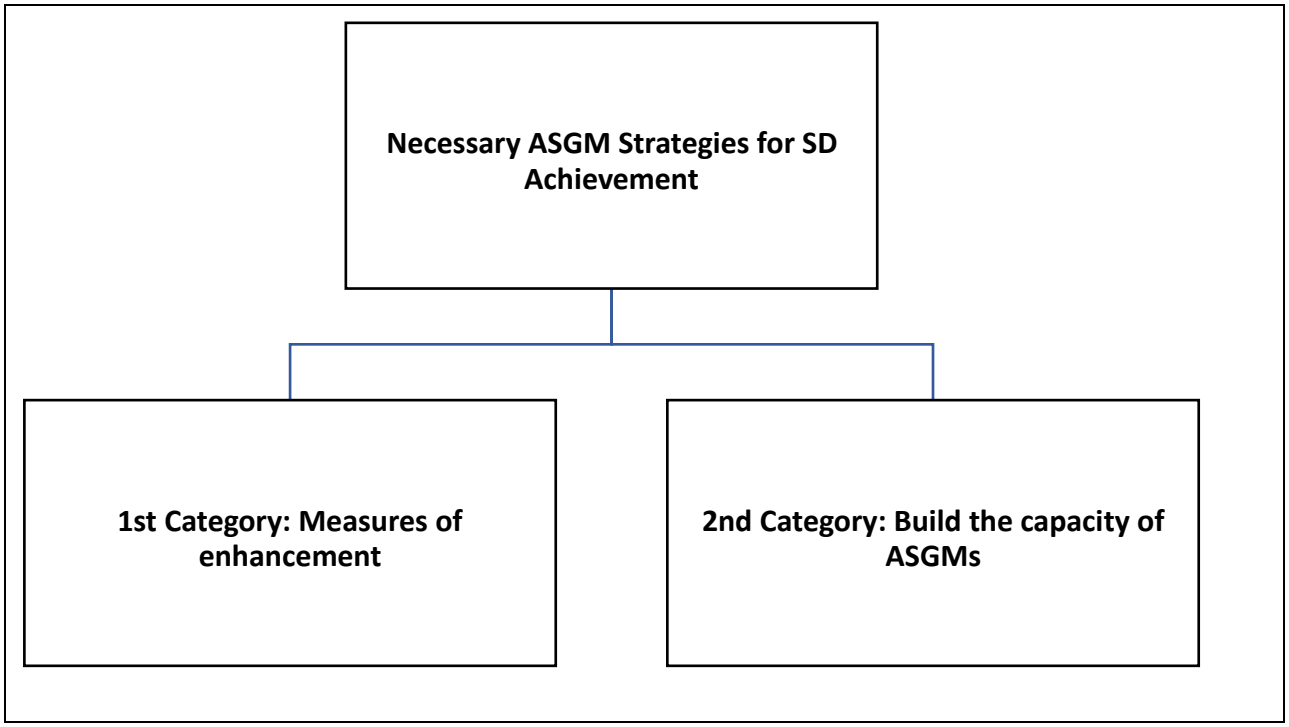


Figure 4. 1Source: Scholar's Own Creation (2024)

The first category of strategies builds on the benefits that are expected to accrue as a result of the activities of the ASGM. This has been identified as the measures of enhancement as illustrated in the figure shown above and this agrees with the recommendations announced by Styles, D'Souza, Al-Hassan, Amankwa, Nartey, and Mutagwaba (2006). The underpinning rationale connotes the interventions to build the capacity of the ASGM operators in a bid to optimise social investment by mining investors. It also shows attempts to promote policy measures that fundamentally aim at sustaining those benefits derived from the ASGM activities and optimizing the potential that is associated with such activities while minimizing risks and shocks. It may include reviewing policy and regulations to build the capacity of ASM to be more environmentally friendly and economically efficient.

4.2.2. Environmental and Social Effects of the ASGM Mining Activities in the Kadoma District

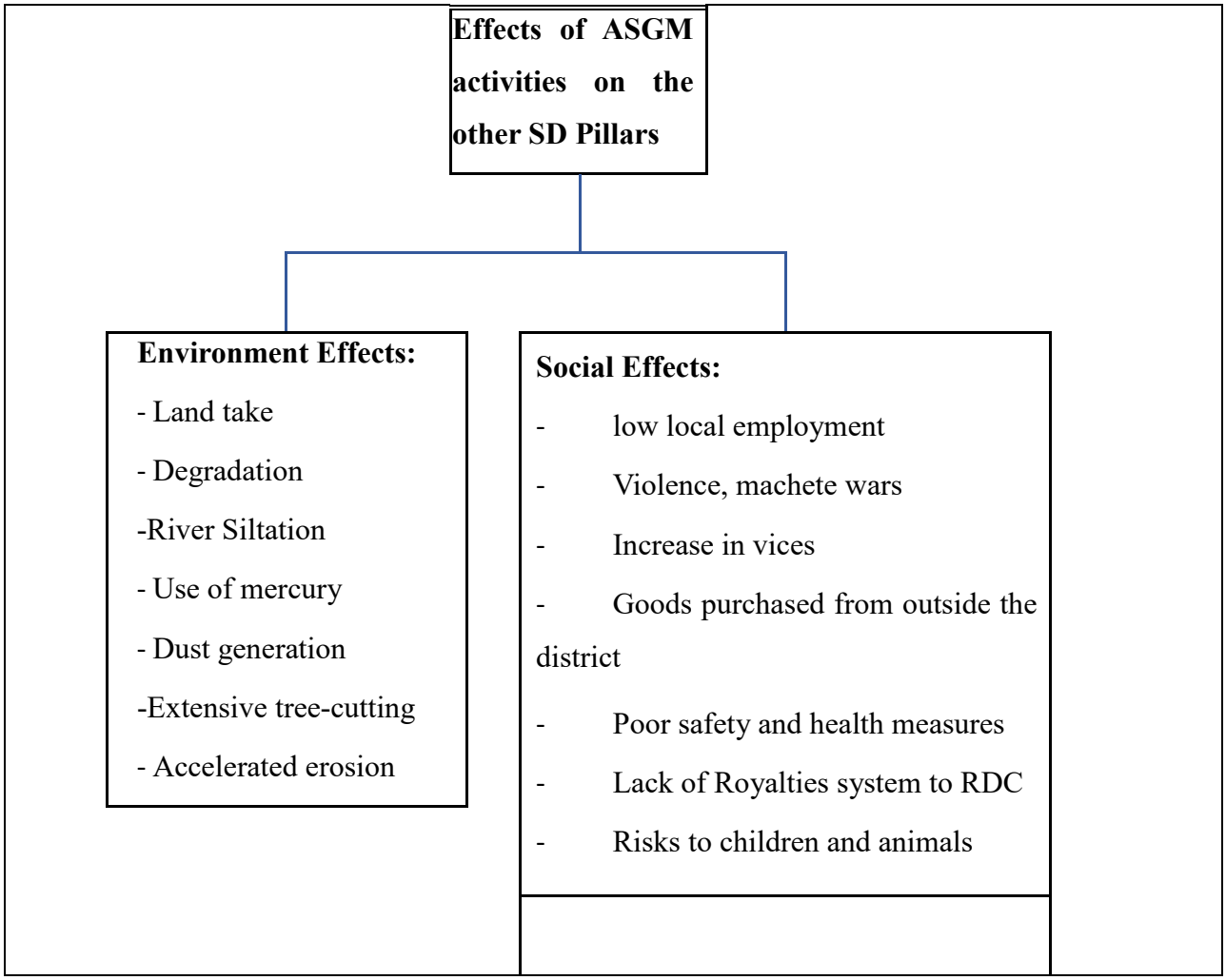


Figure 4. 2 Source: Scholar's Own Creation (2024)

The interviewees noted that pollution of the local water bodies within the Kadoma District was also a major problem associated with mining activities of the ASGM sector. Indications of seepage of heavy metals into underground water sources were a major potential hazard from ASGM mining activities to the natural environment. Some of the local community water sources in Ward 14 such as streams and rivers have been heavily polluted and silted.

These frameworks therefore provide an analytical and programming mechanism for enhancing as well as promoting Sustainable Development through the understanding of the impact of ASGM activities on the livelihoods of the local communities who are critical stakeholders. It is the view of the scholar that this approach is strong in its comprehensiveness as it has allowed for the identification of the short-term, medium-term, and long-term effects of the ASGM activities in a multi-sectoral manner warranting interventions to consolidate or enhance livelihood systems, capacity building, enhance compliance and to promote effectiveness and productivity in the sector.

According to the Sanyati Rural District Council, another key issue was the destruction of the natural environment through the creation of numerous uncovered and therefore open mining pits within the local community's fields, roads, grazing land, and forests. This has created a major worry for traditional leaders, leaders in the Council, and other structures in Wards 14-16, Chakari in which the pits that are left uncovered after mining pose a danger to children and domestic animals' safety and health. Davis (2014), also mourns of a similar scenario in Ghana.

4.2.3. Artisanal Small scale Gold Mining Production and Sustainable Development Model

From the qualitative analysis presented above, the following model has been constructed to portray the relationship between mineral beneficiation and the ASGM sector's contribution toward sustainable development in the mining areas.

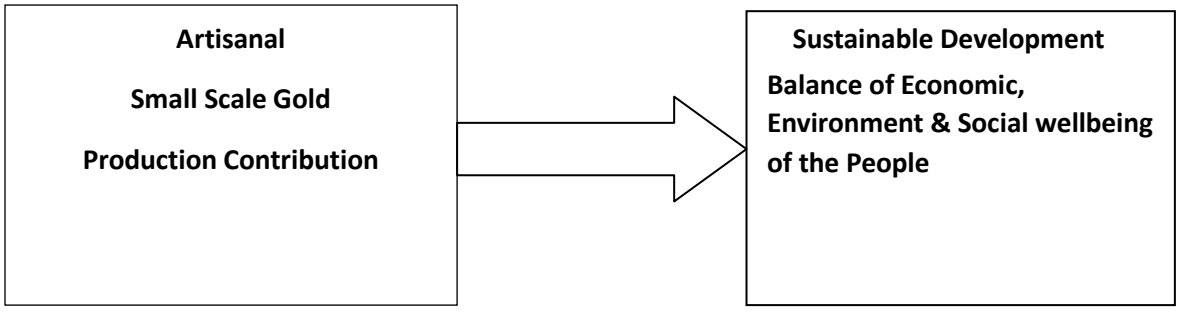


Figure 4. 3: Own Model to Answer the Research Gap

Source: Author's Creation, (2024)

Do ASGM activities positively impact the sustainable development of the Kadoma District?

4.2.4. The Implications of Analysis and interpretation of findings.

The model can be applied in the assessment of the small-scale mining sector in Zimbabwe generally and the theoretical contribution of this study to the existing body of knowledge focuses on the identification of the level of gold production contribution by the small-scale gold mining sector to sustainable development of the areas in which the mining is carried. This study emphasizes the level of gold production as a determining factor in the sector's contribution towards the sustainable development of the mining areas.

It can therefore be said that gold production contributes to the sustainable development of the areas by the artisanal small-scale gold mining sector.

4.2.5. The Enhancement to the Research Analysis and Interpretation of Findings

Findings relating to gold production contribution towards sustainable development of the mining areas showed that to improve the following additions can be made:

i) The use of results from different areas for comparison purposes to allow for generalisations to be made.

ii) Strengthening the application of the DPSIR model in the actual investigation, and construction of the research instruments, and not just using it in the analysis of the results. This would be expected to increase participation by other people who are outside of the research but would assist greatly in adding value to the whole research outcome.

4.3. FINDINGS AGAINST THE RESEARCH OBJECTIVES

4.3.1. To determine the gold production economic effects of the ASGM on the operators and within the Kadoma District

Regarding the ASGM activities' effects on the economic development of the operators and Kadoma District, the respondents gave feedback as reflected below. The purpose of the question was to establish the effects of the ASGM activities prevailing in Chakari on the economic development of the operators, the stakeholders, and the Kadoma District at large.

Responses	Amount of Responses
Disgree	9
Strongly Disagree	30
Neutral.	3
Strongly Agree	5
Agree.	4

Figure 4. 4 Source: Scholar's own

The figure given above reflects that 9 respondents disagreed and 30 strongly disagreed, whilst 3 were neutral and the rest 5 and 4 indicated agreement and disagreement to the assertion that gold production had contributed to the economic development of the ASGM operators and the District. The conclusion here is that whilst gold has been produced in large quantities it has not always helped the operators economically. This scenario is the one clearly depicted by the Natural Resource Case Theory as Wekwete (2019) posits that, the schools of thought are divided between those who argue that mineral resources are a curse and that, in general, growth in mineral-rich and dependent economies has been worse than in less endowed countries.

4.3.2. The current gold production methods and strategies have not considered the need for sustainable development

The questions in this section were to consider whether the current gold production methods and strategies used by the ASGM operators had any consideration of sustainable development requirements as required by the EMA legislation under Environmental and Social Impact Assessment to balance the three pillars. The feedback is reflected in the following pie chart.

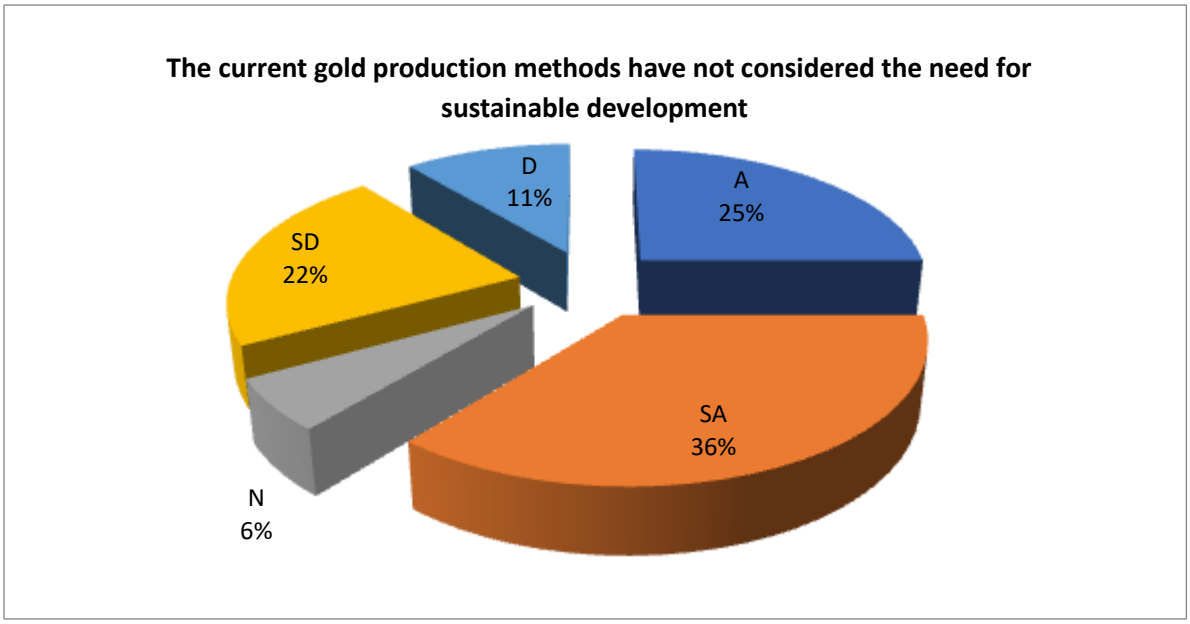


Figure 4. 5 Source – Primary Data, 2024

Key

A – Agreed SA – Strongly Agreed N – Neutral D – Disagree SD – Strongly Disagree

It is clear as reflected in the figure given above where 25% agree and another 36% strongly agree that the current gold production methods have not considered the need for sustainable development as reflected by the extensive water pollution, river siltation of the highest order, and degradation of the environment. Of the respondents, 6% were not sure probably due to a lack of knowledge on how the three pillars need to be tied together. On the remainder of the respondents, 11% disagreed and 22% strongly disagreed and most likely these are the operators who wanted to evade the responsibility of reclaiming and rehabilitating the mined-out areas as demanded by the Environmental Management Act Chapter 20:27 of 2003 as enforced by EMA.

4.3.3. Challenges associated with ASGM operations

Isolate the challenges that the ASGMs encountered in their operations within Chakari in the Kadoma District.

The intention was to isolate the challenges the ASGMs encountered in their operations within Chakari in the Kadoma District. The feedback received was used to construct the following figure.

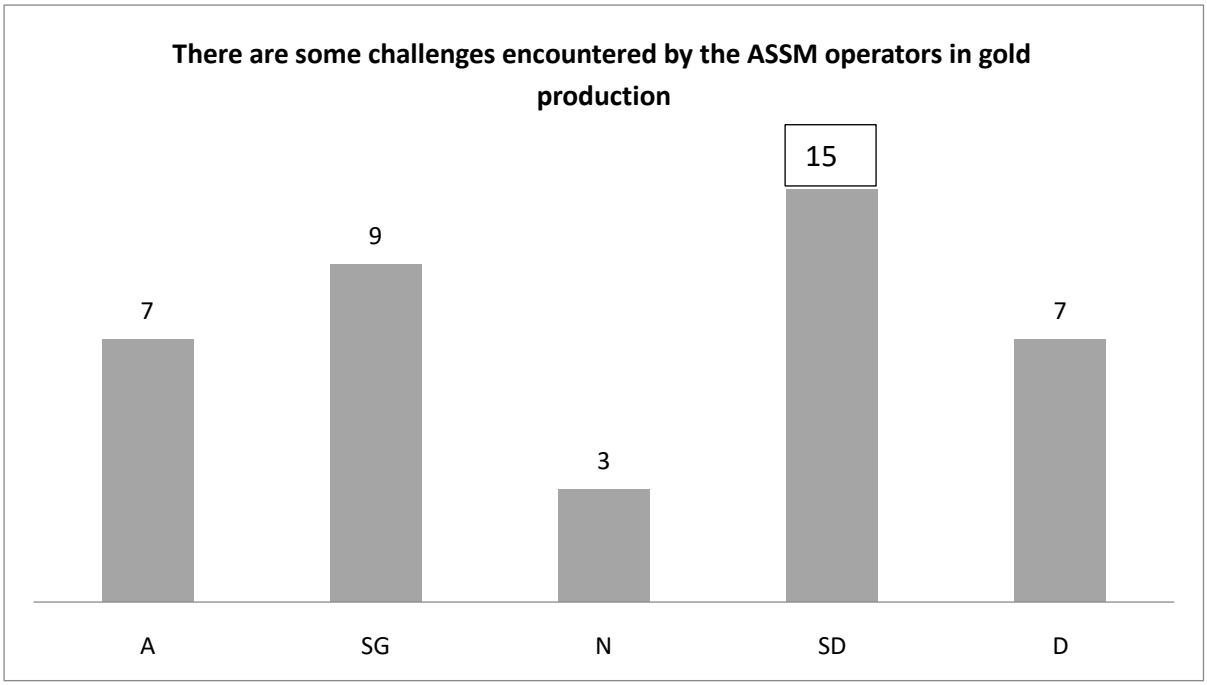


Figure 4. 6 Source: Primary Data (2024)

In terms of isolating the challenges that the ASGMs encountered in their operations within the Kadoma District Wards 14-16, the respondents indicated that 7 were in agreement, 9 strongly agreed, 3 were unsure, 15 were in strong disagreement and the last 7 disagreed. The conclusion in this section is that the ASGM sector was experiencing some challenges including a failure to understand the need to balance the three pillars of sustainable development, lack of technical know-how in executing proper mining methods, and lack of appropriate tools and equipment for their work.

4.3.4. challenges that interfere with gold production in Kadoma District

There was a need to determine what challenges were affecting gold production, The responses are reflected in the figure below.

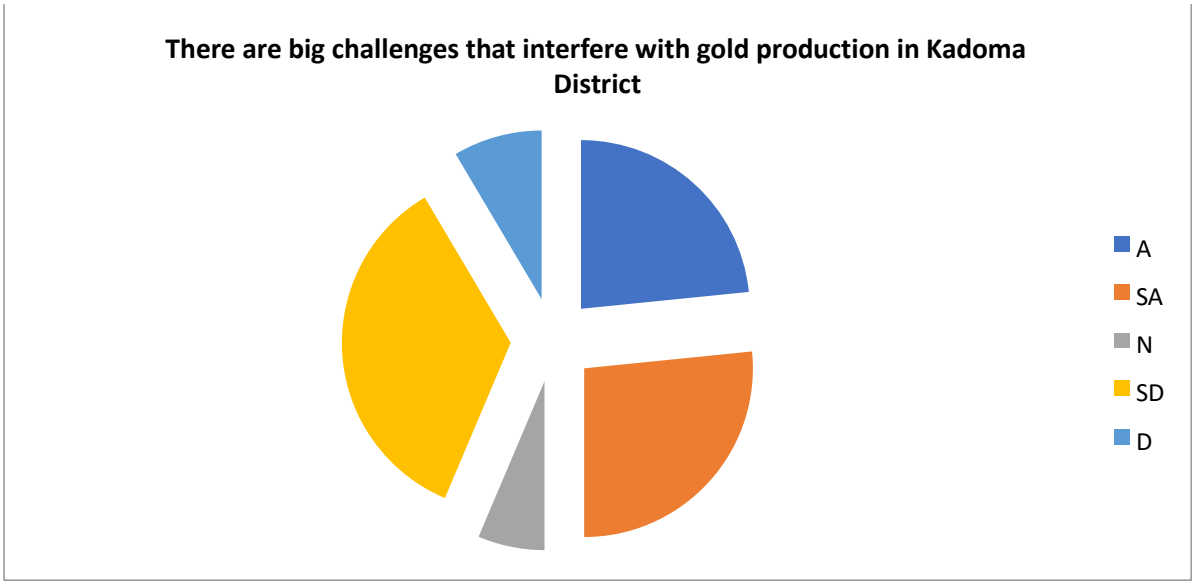


Figure 4. 7 Source: Primary Data (2024)

The combined total of those who agreed and strongly agree was more than for all other categories and therefore the conclusion in this section is that the ASGM sector was experiencing some big challenges that interfered with gold production in Kadoma District Wards 14-16 and in the interviews, these were indicated as poor equipment and tools, low-level competency, legal breaches (non-compliance), lack of financial support from banks and from the government, "machete" fights among the different groups, running battles with the police, EMA, RDC, and MOMMD officials.

4.3.5. Degree of compliance with local environmental legislation

The study intended to determine the degree of compliance by the ASSM to local mining and environmental legislation which is a key determinant towards effecting sustainable development by these ASGM operators. Their feedback was captured as reflected in the figure given in page 78..

4.3.6. ASGM operators and possession of mining licenses

Determining the degree of compliance was done by checking the ASGM's possession of licenses allowing them to own and operate a mine. The licenses required include the following:

- Ministry of Mines and Mining Development (MoMMD)
- EMA's EIA licence for environmental management
- Rural District Council's Royalties payments receipts

- Zimbabwe Revenue Authority tax clearance certificate
- Gold possession licence from the Central Bank, fidelity printers
- National Social Security Authority (NSSA) for employee health safety insurance and pension

ASGM Operators hold Mining licences

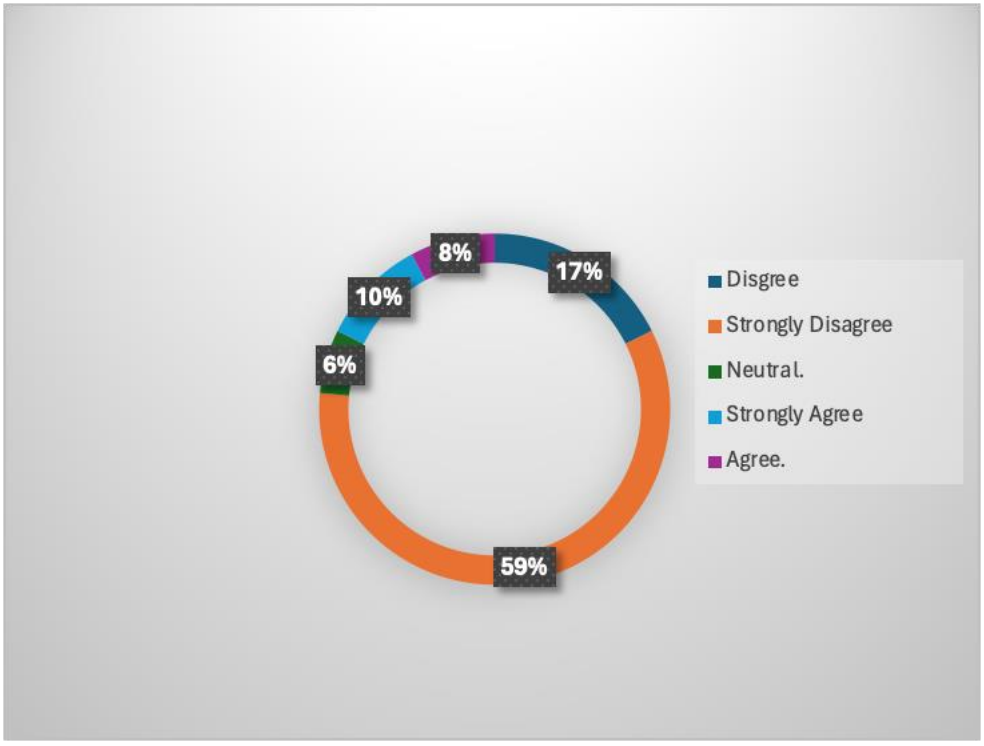


Figure 4. 8 Source – Primary Data, 2024

The ASGM operators are required to possess various types of licences to operate the mine under different legislation as described above and the figure shows that those who disagree and strongly disagree were more than those who agreed as reflected by the relative areas for each category of responses. The conclusion in this section is that many of the ASGM operators did not possess the required licenses and in the interviews, it was indicated that the licenses were expensive, the process of getting the licenses was arduous such as the EMA EIA can take up to 12 months to get all the procedures accomplished and maintain regularly as needed by the law. By implication where there is low-level compliance to possession of licences, the ASGM sector is unlikely to comply with reclamation and rehabilitation requirements.

4.3.6. There are no Occupational health and safety measures being implemented at the ASGM Mines

There was a need to appreciate the implementation of health and safety measures by the ASGM operators.

Feedback from the respondents is reflected in the figure below.

No occupational Health and Safety measures are being implemented in the ASGM Activities.

Key:

1-Neutral; 2-Strongly Agreed; 3-Agreed; 4-Disagree; 5-Strongly Disagreed

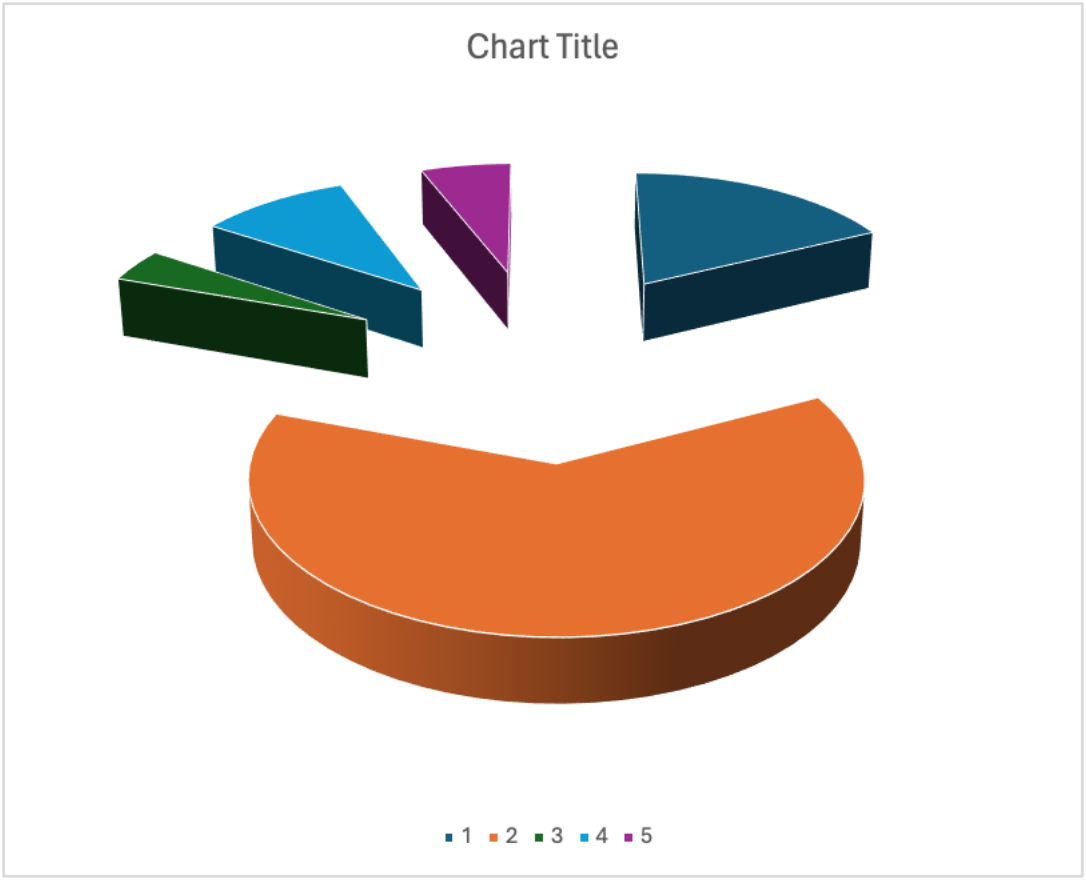


Figure 4. 9 Source: Primary Data (2024)

The respondents who agreed that no health and safety measures were being implemented at the ASGM Mines were 64% of those who agreed (19%) and strongly agreed (45%). The conclusion in this part is that the ASGM largely was not implementing safety and health policies and procedures as required by the law. NSSA reported that as many as 109 workers

perish at the workplace every year and up to 20,000 more workers get seriously injured in the workplace annually.

SECTION E: LEVEL OF COMPETENCY

The importance of competency is that ASGM operators show their abilities in effecting appropriate mining processes (economic objective), environmental protection (earth/planet objective), and social well-being (people objective).

4.3.7. Identification of the level of competency of operators within the ASGM sector in adopting sustainable development strategies in the gold production methods

There was a need to determine the level of competency of operators within the ASGM sector in adopting and effecting sustainable development strategies in the gold production methods and the feedback was processed as reflected in the figure below.

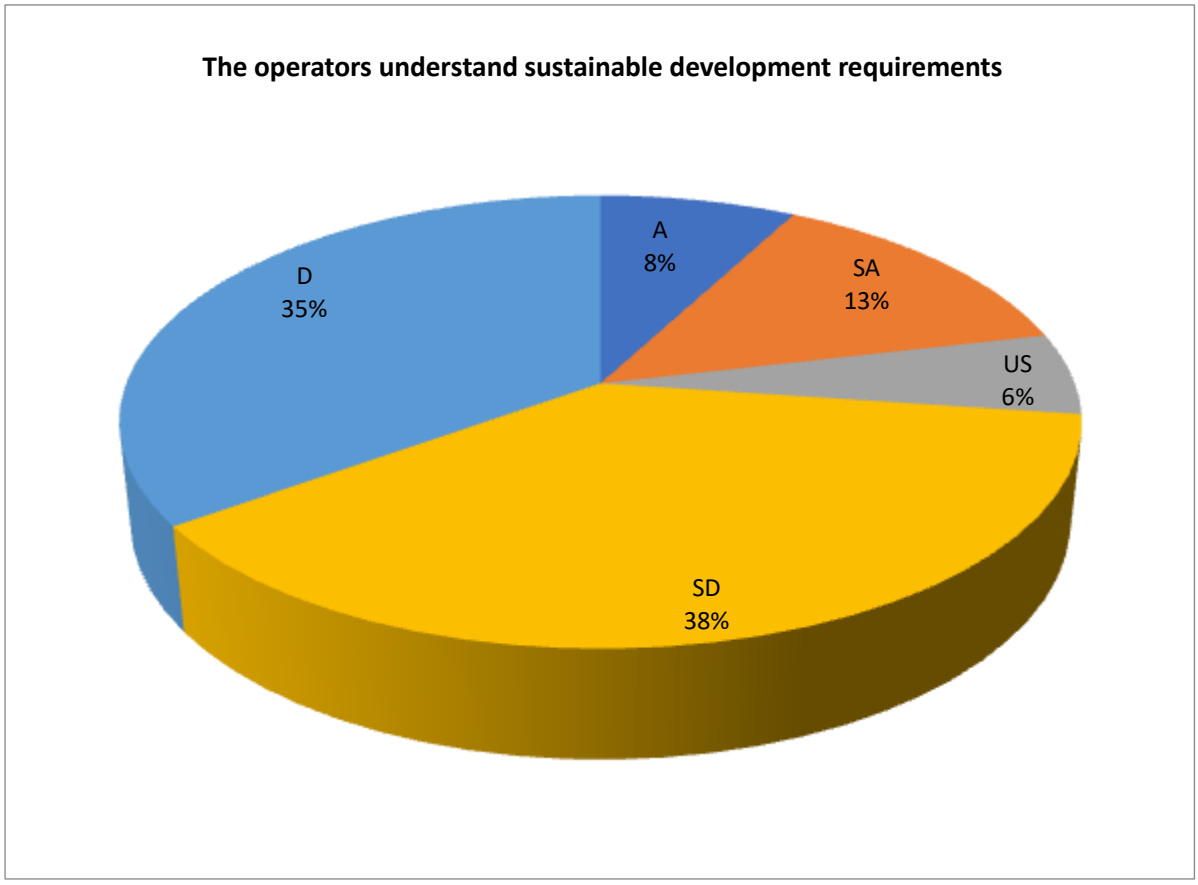


Figure 4. 10 Source: Primary Data (2022)

In terms of identifying the level of competency of operators within the ASGM sector in adopting sustainable development strategies in the gold production methods, the feedback from the respondents reflected that 38% strongly disagreed and 35% disagreed with that

position. The findings in this section is that from this identification of the level of competency of operators within the ASGM sector in adopting sustainable development strategies in the gold production methods, the operators were largely incompetent, and in the interviews, the ASGM operators were not trained and they did not attend the workshops organised by the MoMMD to gain technical competency. In agreement with the assertion of Baah-Ennumh, Forson, and Mmbali (2020), this lack of competency affects the mining methods adopted, and a lack of attention paid to the other sustainable development pillars.

4.3.8. The ASGM operators understand the requirements of the legislation

As part of the assessment of the competency factor, it was necessary to ask if the ASGM sector understood the requirements of the legislation under the various government departments.

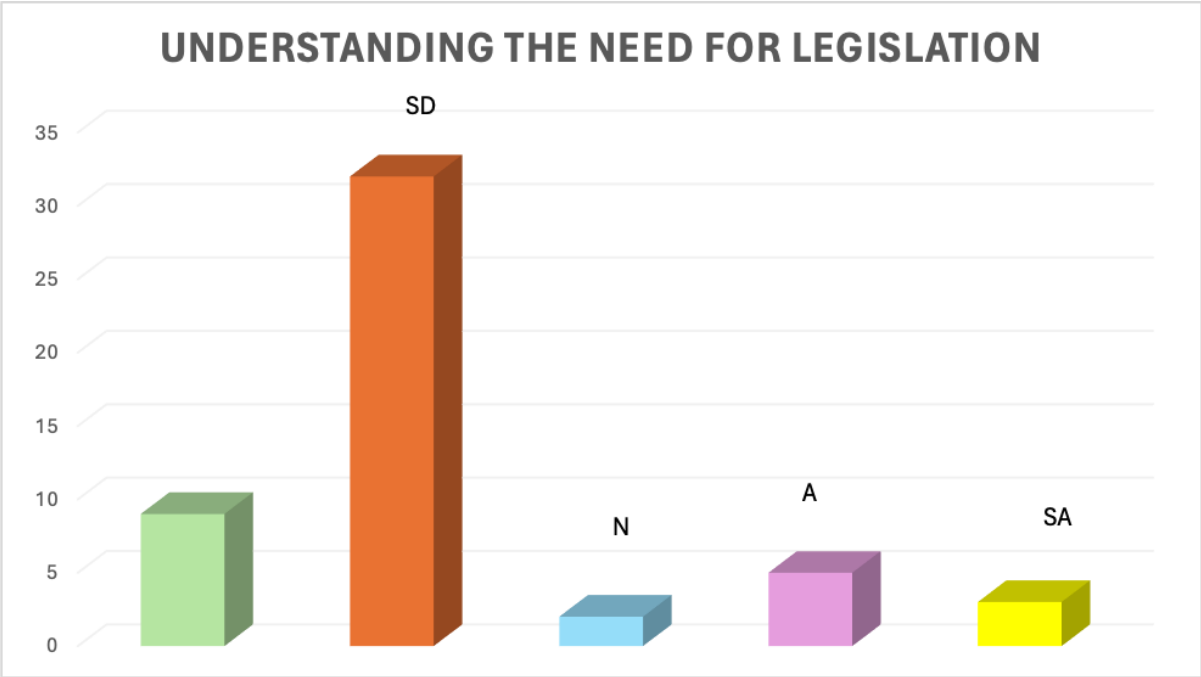


Figure 4. 11 Source: Primary Data (2024)

In terms of whether the ASGM sector players understood the requirements of the legislation the feedback given is reflected in the figure above in which 10, 31, 3, 5, and 2 of the respondents disagreed, strongly disagreed, unsure, strongly agreed, and agreed respectively. The conclusion in this section is that ASGM players did not quite comprehend the basic legal requirements of the following government departments as shown in Table ZY below.

Table 4. 2 Computed from Primary Data (2024)

	Regulatory Authority	Requirements/Legislation/Sustainable Development Pillar supported
1	Ministry of Mines and Mining Development (MoMMD)	Economic pillar/ mining law
2	EMA's EIA licence for environmental management; Rural District Council's Royalties payments Receipts	Environment pillar/ environmental law; Health, Reproductive health, Housing, Roads, Potable water, Biodigesters – Waste management
3	Liquid Intelligent Technologies; TelOne	Broadband Connectivity; Smart mining; Connectivity; GPS; Database
4	Zimbabwe Revenue Authority tax clearance certificate	Economic pillar/national fiscus contribution
5	Gold possession licence from the Central Bank, Fidelity Printers & Refinery	Economic pillar/national fiscus contribution
6	National Social Security Authority (NSSA) for employee health safety insurance and pension	Social protection law/ occupational safety and health legislation

Source: Computed from Primary Data (2024)

4.3.9. Understanding of health, safety, and environmental protection procedures to be undertaken during mining

There was also a need to determine if the respondent's understood health, safety, and environmental protection procedures to be undertaken during mining activities. The implication is that if they did not understand the procedures to be taken then they were unlikely to undertake related measures.

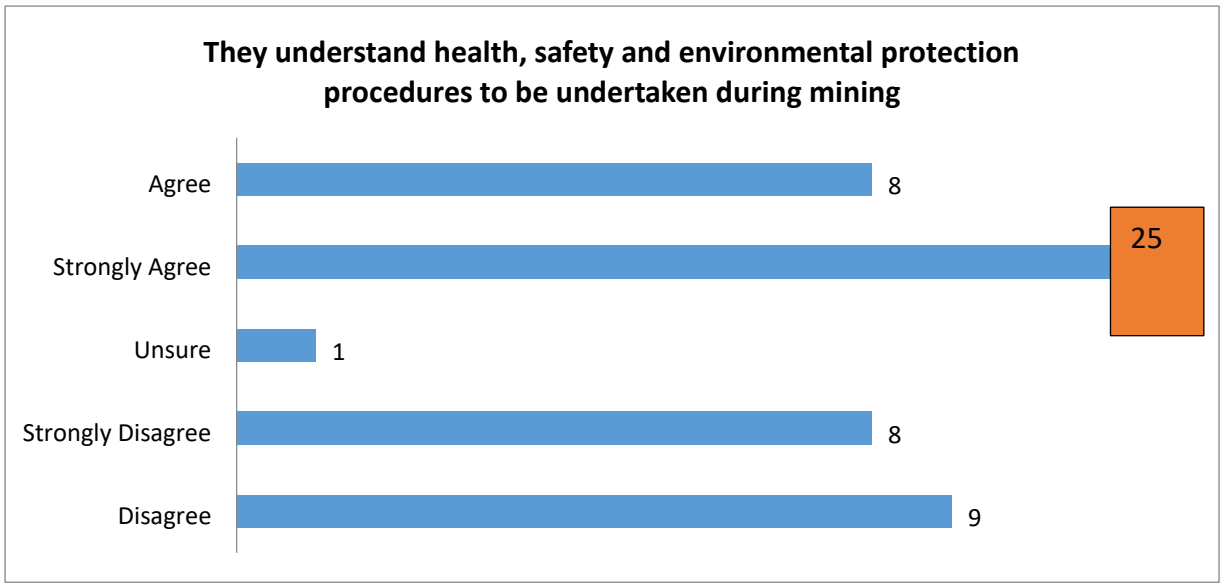


Figure 4. 12 Source: Primary Data (2024)

Of the feedback from the respondents on whether there was an understanding of health, safety, and environmental protection procedures to be undertaken during mining activities by the ASGM operators, 65% concurred on the importance of health, safety, and environmental protection being core to sustainable mining. The majority of the remainder 35% did not have an appreciation of health, safety, and environmental protection procedures being executed during ASGM activities. Feeney (2016) insists that the OECD principles attempt to balance the three pillars which are economic, environmental, and social wellbeing of which the safety and health of employees and the local community's children and domestic animals are a major part of it.

4.4. ACHIEVEMENT OF STUDY GOALS (DID THE RESEARCH SOLVE THE PROBLEM)

The study focused determining suitable solutions to environmental and socio-economic problems faced by the mining areas in the rich gold belts such as the Kadoma District in Ward s14-16. These challenges manifest in the form of low formal employment within the local communities, extensive environmental degradation, and failure to comply with local, mining, environmental, health, and safety legislation. The mining sector has been identified as one sector that can play a leading role in reviving the economy. As the country braces itself up for 2030 declared as the year by which Zimbabwe will attain an upper middle-income status, the mining industry has had a target set of $12 billion. The figure is made up of a large contribution from gold production.

It is therefore clear that the Zimbabwean national economic discourse is anchored on finding sectoral economic opportunities with the hope that if these gold mineral resources are exploited, there could be economic progress. The research, therefore, plays a central role in searching for possible solutions to improve the economic performance of the nation while ensuring inclusive growth as guided by the three pillars of sustainable development. This study contributes to the national discourse on the national economic progress, environmental management, and social well-being. Essentially, the study presented an opportunity for key parties in the country to comprehend the challenges and opportunities in the ASGM mining sector towards the need to balance the three pillars of SD and more so attempting to understand all these from the perspectives of the ASGM players and the affected local communities. While the study hovered around the work of the artisanal small-scale gold mining sector, it had the potential to open up more debate in terms of how mining by the small-scale operators has ruined the countryside leaving numerous orphan sites, and how that could be turned around, especially with the coming in of EMA who enforce environmental management legislation. The supposition is that this could be achieved by evaluating sustainable development-related opportunities in the areas where the ASGM operators' activities are concentrated.

The study managed to unpack the issues on sustainable development in Chakari within the Kadoma District, and this seems to be the same trend right across the mining districts in Zimbabwe. The study brought to the fore key issues in SD as follows:

ASGM Activity levels from the study areas

- Very low environmental management in the gold mining areas of Kadoma, evidenced by extensive environmental degradation
- Low-level competency of the ASGM operators
- Non-responsiveness and lack of proactivity by the line Ministry, and regulatory agencies.

Failure by the sector to observe minimum mining, environmental, safety, and health legal requirements and unwillingness on the part of the ASGM operators to plough back money into the local communities through CSR or even paying royalties to the RDCs. o a certain extent, the solutions to bring alive the three Sustainable Development pillars have also been isolated and these include:

- Attending short workshops by the ASGM operators to increase their level of competency and knowledge around Sustainable Development balancing
- Ensuring that there is a resident mining and environmental officer to assist the ASGM sector with technical expertise.

It also revealed that there was still room for improvement in the application of sustainable development of the small-scale gold mining sector. Eventually, this would positively impact the local community and other key stakeholder expectations.

4.4.1. Discussion on the Research Objectives

The study objectives have been established to guide the study on generating a smart architecture for transforming ASGM activities and their impact, strategies, and methods on Sustainable Development. sustainable development within the Kadoma District and these can be stated as:

4.4.1.1. To examine the causes and impact of artisanal mining on sustainable development in Kadoma District.

4.4.1.2. To identify and evaluate strategies used in ASGM in Kadoma District.

4.4.1.3. To develop a smart architecture for sustainable development in ASGM.

The objectives set for this study did not change during the research process as these were deemed to be quite encompassing of all the issues in the ASGM sector around sustainable development issues. Sekeran and Bougie (2015) insist on following set of objectives because big changes may result in different research altogether. Contrary to this view on research objectives, Punch (2005) posits that research objectives can be modified along the course of the research project as the researcher tries to align with the realities on the ground.

4.4.2 The Purpose of the Research: Discussion

The purpose of the study was to assess the process of gold production and its contribution towards sustainable development in the artisanal small-scale gold mining sector in Zimbabwe. This was done through a study of small-scale gold mining in the Kadoma District. When reviewing the mining development discourse, pertinent issues concerning the need to balance the three pillars of sustainable development and the general growth of artisanal small-scale gold mines remain topical (Amankwah and Anim-Sackey, 2003). The ASGMs should strive to break barriers for them to balance the three pillars of SD. Many

scholars have identified the main challenges being faced by these ASGMs as low-level competency by the operators and failure to comply with the most basic minimum legal requirements.

Sustainable development in the mining sector seems to be quite elusive even by the big players and more so by the ASGM operators who are unwilling to spend their hard-earned money on reclamation and royalties. Although the study was restricted to the Kadoma District Ward 14, it was hoped that the findings would be able to proffer solutions to the nation in so far as ASGM activities and sustainable development objectives were concerned.

4.4.2.1 The Research Methodology: Discussion

This study was modelled on qualitative research strategies since it was motivated by exploring the various characteristics and behavioural tendencies in artisanal and small-scale mining activities. The research sought to investigate, strategies, and methods of mining, and their effects on sustainable development. Furthermore, it sought to develop a smart architecture with the aid of the experiences of the ASGM operators, and key stakeholders, and with the aid of the various theories and international, regional, and local experiences, and regulations. In formulating the methodology, the researcher relied on the research hypothesis and the research questions. The hypothesis assumed a positive relationship between gold production with sustainable development in the ASGM. The study depended on primary data collection using interviews which enabled a thorough deductive approach for analysis of data.

The adopted research methodology enabled the researcher to get the view from the artisanal small-scale gold miners themselves and verify these with the opinions of key informants as detailed in the interviews. This was considered a departure from investigations covered by scholars such as Lungu (2015) and Jordan (2015), who conducted desktop research in studies related to the small-scale gold mining sector.

4.4.2.2 Discussion on the Research Proposition

This section gives a discussion based on the research proposition as given earlier as to whether these were confirmed or disproved as the research progressed. The causes and impact of the ASGM activities on sustainable development in Kadoma District, while with some marginal benefit of supporting livelihoods, had far-reaching adverse ecological and social ramifications. Note the following:

- The implication is that the ASGM sector needs to leverage the national aggregate gold throughput to invest part of the harvested ounces into environmental management (through pollution minimisation, reclamation of degraded areas, promotion of safe alternative gold-extraction technologies compared to the globally specified hazardous mercury, which is currently being washed and disposed into the earth, and rehabilitation of the open pits).
- Some gold proceeds should be channeled towards enhancing local economic development in the Chakari area, in Kadoma District through royalties to the RDCs. The gold also has the potential to change the economic fortunes of the mine operators, their families, and their relatives.
- There is a need to increase the level of awareness for sustainable development and basic financial intelligence appreciation to the operators to make decisions relating to budgets so that part of the proceeds is plowed back into the mines themselves as well as into the communities in which the mines operate.
- Gold production processes by the ASGMs do not comply with local environmental legislation leading to poor sustainable development effects from the strategies and methods used.
- The ASGM activities do not comply with the local environmental legislation. The conclusion from this was that the ASGM operators largely disregarded the requirements of the law. They ignore the mining, environmental protection, and Rural District Council legal requirements. The implication is that the ASGM operators were always having running battles with the Zimbabwe Republic Police (ZRP) and EMA who will be trying to enforce the requirements of the law.
- The use of mercury has been banned but the players in the ASGM sector continue to use it and, in the process, endanger their lives, handling it, and also causing pollution of the water with sediments which is used by the local community are dangerous too.
- The ASGM operators have been working without the minimum personal protective clothing (PPE) and there is a breach of health and safety regulations and the rights of communities and public health.
- The competency of the operators in the ASGM activities are not affecting the sustainable development processes within the Kadoma District was rejected whilst the alternative hypothesis H_2 was accepted which stated that the competency of the operators in the ASGM sector positively and significantly affected the sustainable

development processes in Kadoma District. This acceptance implies that the ASGM operators need to cultivate their competency in terms of using better mining strategies and methods and comply with the mining, environmental, safety, and health requirements.

- Thus, the findings cede impetus to the need for a smart architecture that will afford the entire ecosystem rounded and solid interlocked coordination, support, and balanced sustainable development to the operators, communities, enhancement of the attainment of the US$12 Billion mining economy, and all stakeholders.
  It is necessary to conduct training workshops that place these operators at the centre of sustainable development.

4.4.3 Discussion of the Findings as Guided by the Research Objectives

In pursuing this discussion on sustainable development in Chakari, Kadoma District, the first logical step was to establish the understanding, appreciation, and competency in the proper mining methods and the general requirements stated by and from the legal authorities of these ASGM operators.

The study established several small-scale gold mining activities in the Kadoma District Wards 14-16. These artisanal small-scale gold mining activities were characterized by operators with rudimentary mining strategies and low income as cited (Zvarwadza, 2018). They were limited to the mining of mostly gold using rudimentary methods. The study considered the effects of the ASGM activities on the sustainable development of the area. Issues such as ASGM competency, adherence to local and international laws, reclamation of the degraded areas, local economic development, and royalties towards the activities of the RDCs. It further looked at the small-scale gold mining activities in terms of legal compliance, social license, local development, and sustainable development, which is a departure from using only economic development variables such as employment (Hawkins, 2000).

The study concluded that there was significant ASGM gold production activities, however, this was not supporting local sustainable development as evidenced by extensive environmental degradation and the cash-strapped Sanyati Rural District Council.

In terms of the first objective which intended to determine the strategies and methods of the ASGM activities and their effects on sustainable development within the Kadoma District, it

was noted that the Kadoma District Wards 14-16 area had rich gold deposits which lend themselves to mining with basic crude mining methods. That the area is rich cannot be mistaken judging by the types of cars that visit the area, the number of illegal gold buyers, and the high presence of fleecing ZRP Officers. The country has set a target of $12 Billion and in the past two years, the largest gold contribution has been delivered by the ASGM players, who injected as much as 64% into the RBZ coffers. This is despite the huge gold leakages that ASGM players sell to middlemen who likely smuggle the gold outside the country. There has not been any progressive participation and contribution by the ASGM players towards the sustainable development requirements of the area. The area is currently extensively degraded, with open pits, devoid of any vegetation. . The biodiversity of the area has been disturbed with most wild animals in a non-existent state due to poaching and destruction of their habitat.

There are several challenges that the sector ASGM was facing and these included the following:

- The ASGM operators lack competency in proper mining methods.
- They lack resources such as access to adequate mining equipment and tools
- They continue to utilise old mining and mineral processing technologies such as manually digging the ore, use of mercury in picking the gold as well as other chemicals such nitric acid.
- They lack appreciation of the need to undertake reclamation and rehabilitation of the mined-out areas which they leave in a state of extensive degradation.
- They lack proper methods of surveying for the gold and mostly use very crude methods which are inefficient.
- They engage in illicit drugs and local brews which cause them to become unruly leading to machete fights which have led to loss of life and serious injuries. It has on many occasions sucked in the local community members.
- Lack of communication, telecommunication services, broadband services, and digital geophysical profiling.

- The sector is always engaged in running battles with the ZRP, Ministry of Mines and Mining Development and EMA due to their failure to regularise their activities with the regulatory authorities.

The second objective also aims to establish the degree of compliance by the ASGM sector to local environmental legislation and local community expectations, the ASGM sector operators mostly operated with minimum paperwork from the Ministry of Mines and from EMA. They also seem reluctant to formalise their activities lest they are spotted and are required to pay NSSA and ZIMRA which they do not appreciate. The sector also lacks issues to do with social licenses in which they create good relations with the local communities and contribute royalties to the RDC for use in local development programmes such as in road infrastructure. There are always running battles with the ZRP and gold mobilisation squads who will be attempting to enforce the requirements of the law. The ASGM operators do not reclaim the areas where they mine their gold ore, leaving open pits dangerous to domestic animals and children.

The objective is also centred on the need to identify the level of competency of operators within the ASGM sector in adopting sustainable development strategies in gold production methods. The ASGM operators go into the mining sector with little competency inefficient and ineffective gold production methods. They usually lack know-how in effective mining methods and lack tools and equipment that are fit for the job as they mostly use homemade tools and equipment. Their employees follow crude methods coupled with deficient tools as indicated earlier. They also do not attend training workshops organised by the Ministry of Mines and Mining Development. In addition, they also lack appreciation of the need for sustainable development and push everything as the responsibility of the government and yet they are the beneficiaries of the gold mining activities. Whereas the use of mercury was banned, the ASGM sector continues to employ it thus exposing themselves to carcinogenicity and causing surface and groundwater contamination and pollution from the mercury leakages.

4.4.4 The Smart Architecture to Assess the Impact of Sustainable ASGM Economic Activities on Environmental Protection and Human Well-being

The research findings underscore key drivers such as gold activities within the Kadoma District. The model also explains the impact of gold production by the artisanal small-scale gold miners and their work in investing or lack of it in environmental protection and social well-being.

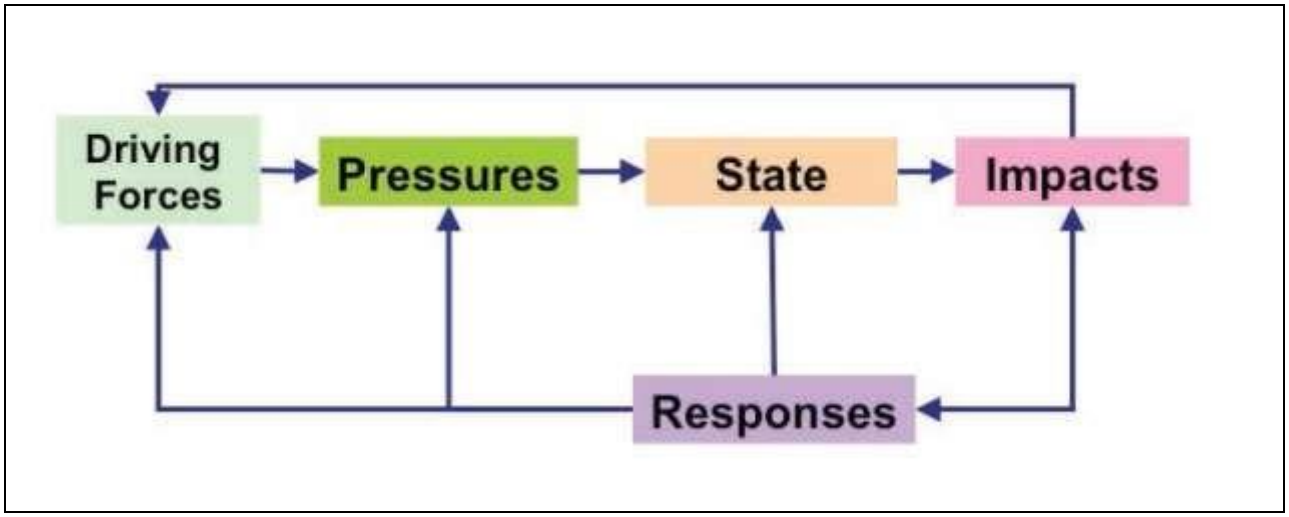


Figure 4. 13: Discussion of the DPSIR application to the Current Study

Source: USEPA (2015)

The current study on gold production contribution towards sustainable development by the ASGM operators in the Kadoma District Ward 14 would as given below:

Table 4. 5. Responses Primary Data

	DPSIR ELEMENT	DESCRIPTION IN THE GOLD PRODUCTION VS. SD IN KADOMA
1	Driving forces	***Economic Drivers in Kadoma District:*** Wealth creation, need for infrastructure development and employment ***Social Drivers in the Kadoma District:*** status, empowerment, employment creation
2	Pressures	***Environmental Pressures***: Environmental degradation, pollution of the soil and water, cutting off trees ***Human Behaviour:*** Failure to do reclamation of mined out pits, continued use of mercury, disregard of environmental health requirements through open defecation, non-existent waste management practices

3	State	***Environmental State:*** Biodiversity, land scouring, animal paths destroyed, mercury in the environment, litter, waste, impassable roads ***Human State***: Ill-health, potential disease outbreaks, carcinogenicity, animal and child safety compromised,
4	Impacts	***Ecosystem Services:*** Increased carbon footprint, decimation of trees hinders carbon sinks and reduction from photosynthetic processes, poor air, and climate regulation ***Human Wellbeing***: Economic deprivation, risks to the safety of local community, ill-heath, cancers
5	Responses	• Reclamation • Rehabilitation • Enforcement of the regulations by EMA, NSSA, MoMMD, RDCs and Ministry of Health & Childcare • Improve through training competency of ASGM owners • Reforestation (see appendix) • Regular monitoring • Mitigation of impacts • International convention to ban the use of mercury

Source: Responses Primary Data

The DPSIR framework implementation was done for ASGM activities' effects on sustainable development as shown in table 4.4.4. given above. It is clear that the causes of the extensive environmental degradation in the Kadoma District Wards 14-16 are driven principally by economic and social drivers, people want to create wealth they need employment and economic empowerment. This immediately generates pressure on the environment and the local communities. The state of these is clear, and visible, mined-out pits everywhere, destruction of vegetation, and biodiversity, impoverished communities with inadequate access to water, bad roads, and exposure to mercury use.

4.4.4.1 Contribution to the small-scale mining sector

This study is critical as it gives some clear explanation to facilitate understanding of the key drivers in artisanal small-scale gold mining activities so that once adopted the sector can decrease conflict with its key stakeholders and consider themselves as good citizenry that can live in peace with the local community in compliance with the local mining and environmental legislation.

Influenced by this study, the artisanal and small-scale gold miners and other miners can consider the wealth of advice given in this report on mining by ASGM versus the need for sustainable development in areas that are affected by the mining activities. The ASGM sector must willingly accept and adopt the sustainable development measures indicated in the report and, for that to happen, it was emphasised in this report that the ASGM operators must take short duration training to improve on their competency and also to willingly comply with the legal requirements by working closely with their key stakeholders, namely, the local leadership, EMA, RDC, MoMMD, NSSA, and the small-scale miner's association.

Advice has been extended to the fact that the ASGM must pay their royalties to the rural district council which are used for the general development of the area, roads, maintenance and schools. Saliently, it has been pointed out that the study findings demand and demonstrate the fact that these ASGMs need to consider their ventures as proper businesses that need to be properly planned for, and run professionally for the benefit of all the key stakeholders identified in the studies including themselves, their managers and workers.

4.4.4.2 Contribution to the Policymakers

From the study findings, it was clear that there is a need to create and conjure up a conducive atmosphere culturally, socially, economically, and politically, government policy, and legislative environment for sustainable development to thrive for the benefit of all the stakeholders. Hence, the policymakers can draw from the findings and make informed decisions that can transform not only the small-scale gold mining sector but the whole mining sector economically.

As discussed in Chapter One, national goals include achieving sustainable development as being propagated in the SDG by the United Nations for the period extending up to 2030, and 2063 for the African Union. This is achieved by improving the livelihoods of nationals through economic sectors by paying attention to the environment which provides humanity with livelihood.

4.5 THE CHALLENGES IN FINDINGS' DISCUSSION

The current research has met its fair share of challenges and limitations. Firstly, the findings may suffer generalisation limitations because they were based largely on the views of the artisanal small-scale gold miners within the Kadoma District. It is possible that any other district could have different challenges in the country. However, the inclusion of other

stakeholders involved in the research such as the RDC, EMA, and MoMMD, who had national outlook exposure seems to mitigate the generalisation challenges. The findings are limited to the views of artisanal small-scale gold miners who were involved in the mining of gold which was the dominant mineral mined out in the District. Despite the fact that there are over seven minerals that were being mined out in the district by the small-scale miners in Zimbabwe. Challenges relating to sustainable development support by other minerals may be different from those discussed here.

4.5.1 Improvements to the Research Study

The research findings and the accompanying discussion of findings could have improved by selecting a larger sample say 200 instead of fifty-one participants and also drawing from a larger population which could include both formal, informal, registered, and unregistered ASGM operators. This is justified because all these categories contribute to gold production, environmental degradation as well as unfavourable conditions occurring in the locally affected communities. For instance, the focus could have been on the province of Mashonaland West instead of just Wards 14-16. This could also have its challenges in terms of funding and access to the respondents.

Plate 4. 1 : Primary Data (2024)





Plate I: BUSE Student Langaton Mabhanga donating 30,000 tree seedlings for rehabilitation of the degraded areas from the mining by ASGMs. (13/04/2024) – prompted by findings from this study.	Plate II: BUSE Student Langaton Mabhanga giving an awareness to school students from Kadoma District at the event to donate 30,000 tree seedlings for rehabilitation of the degraded areas from the mining by ASGMs. (13/04/2024) – prompted by findings from this research.

Source: Primary Data (2024)

Therefore, the choice of the Kadoma District Wards 14-16 for studying the work on SD by the ASGM operators was based on the practical considerations and observations in the local areas, as such, this unusual research work actually and necessarily provided interesting and challenging research results as presented and analysed in Chapter 4.

4.5.2 Research Findings – The Challenges

According to Politano, Walton, and Roberts (2017), data collection and its related processes have limitations that are embedded in the researcher, the participants, and the environment. The researchers' bias may affect data collection as respondents may not have the liberty to their views. Respondents for this study were asked to complete Likert scale questions indicating their levels of agreement with the designed questions. Although the participants were asked to give additional comments at the end of the questionnaire, this Likert scale approach did not give the participants the leeway to expand their views on the various concepts of the questionnaire. Politano et al (2017) further assert that participants may choose not to provide information they may regard as sensitive. Due to the politically charged environment in Zimbabwe at the time of the research, participants were reluctant to give their views which could have exposed their political affiliations.

There were a lot of timidity and people were supposed to be cautious with their associations. Some small-scale gold miners had to be measured in their associations and utterances. However, the researcher provided adequate warmth and assurance that the study was only for academic purposes. Ultimately, some stable interviewees participated in the interviews.

4.5.3 Research Findings: The Gaps

As indicated in the previous paragraph, the researcher was not able to collect information from small-scale operators involved in the mining of other minerals such as chrome, platinum, antinomy, and talc, therefore the findings would be limited in terms of generalisations to mostly the ASGM sector in Kadoma District as different mineral operations may have peculiar characteristics not captured in this research study which focused on the gold production and its contribution towards sustainable development in the Kadoma District.

4.5.4. Improvements required for the research findings

To improve the findings of the research the researcher suggests the following measures to be taken:

i) It would also be helpful to increase the number of wards outside of Chakari from which data collection is undertaken, this would remove specific area bias which may therefore introduce outliers and distortions to the results.

ii) Whilst most of the data was collected from the ASGM operators with the qualitative data collected from the government-related institutions, the results may be improved by widening the net for interviews.

4.6. CHAPTER SUMMARY

The chapter discussed the study findings of the research in relation to other scholar's findings as well as to international perspectives such as by the United States Environmental Protection Agency (USEPA), Environmental Protection Agency (EPA) in the United States of America, Organisation for Economic Co-operation and Development (OECD), and compared to those studies done in Ghana using the crucial model of DPSIR. It outlined the major activities which were undertaken by the researcher since the commencement of the research process starting with the topic through to analysis, interpretation, and discussion of the results. It was ascertained that the expected outcomes of the research were adequately attained. The study managed to come up with findings that confirmed that gold production had a huge potential economically and with a better organisation can stimulate the support for environmental management and social development in the local areas as contributed by the small-scale gold mining sector. The other matters that were looked at were the academic journey travelled so far, the researcher's model, and the discussion of the findings. The

researcher has the view that the research has served its role. The next chapter which winds up the research.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

This chapter presents the summary, recommendations, and conclusions. The researcher drew novel interventions for the ASGM and stakeholders in generating a smart architecture that instills sustainable development in the Kadoma District. The perspectives for future related potential research gaps are proffered in this chapter. The discussions in this chapter focus on relevant and practical interventions that constitute the novel smart architecture to propel sustainable development in the Kadoma Mining District in Wards 14-16. This study's objectives, were:

- To examine the causes and impact of artisanal mining on sustainable development in Kadoma District.
- To identify and evaluate strategies used in ASGM in Kadoma District.
- To develop a smart architecture for sustainable development in ASGM.

5.1.1. The Research

This dissertation examined the potential of Artisanal Small-scale Gold Mining (ASGM) as a strategy for the sustainable development of the Kadoma District. This potential is determined by the ability of the ASGM activities to drive sustainable development, which have been identified as economic sustainability that supports livelihoods, employment generation, delivers prosperity, infrastructural economy, human competencies for integrated social progress, and environmental protection, and ecological sustainability in Wards 14-16. The study focused on the sustainability of the ASGM in Wards 14-16 within the Kadoma District, Mashonaland West Province, Zimbabwe. It explored the impacts and role of the ASGM activities in enhancing the sustainable livelihoods of the gold miners and local communities, by facilitating access to the different assets mentioned earlier.

5.1.2. The Summary of the Research Findings

The major objective of the research was to generate smart architecture for the ASGM sector that enhances sustainable development in the Kadoma District. The mining area is extensively degraded with pits, trees completely cut down, destruction of the local topography, and a big contribution towards carbon footprint. The ASGM operators use mercury which is a dangerous chemical that causes cancer and is now banned for use under the Minamata Convention. The ASGM operators do not reclaim the areas which they mine

out and seem to consider that as the government's responsibility to rehabilitate the degraded sites and they are the ones who benefit from the mineral's extraction and sales. The local community has not significantly benefited from the resources being mined from their area and in fact, they have suffered from degradation as a result of the following:

a) Very low local employment, as the ASGM Operators bring their people from outside of the ward.
b) Most of the shopping is done in Kadoma City thus side-lining the local shops based at the local business centres
c) The pits have paused danger to the domestic animals owned by the local community
d) The increased population in the area has also attracted thieves who steal assets from the local community
e) Domestic animals have fallen prey to the mostly illegal SSGM who seem not to respect other people's possessions
f) Serious violence has erupted many times between and among different camps that have caused deaths and serious injuries to miners and some members of the local community
g) The local community cannot freely do their work at night or during the day for fear of being attacked and dismembered.
h) Local agricultural activities have been stalled and the Ward 14 is a net importer of food including the staple maize food from areas such as Sanyati and Gokwe.
i) The ASGM operators do sell their gold a lot more to third-party buyers whilst evading the RBZ buyers. This means the ASGM is contributing to the gold leakages out of the country
j) The illegal ASGMs use machetes and have become a serious threat to peace and tranquillity within the local community
k) The high liquidity of the ASGM operators attracts commercial sex workers to the area and reports of local shops running out of condoms have been reported on several occasions
l) The local clinic has also reported a higher number of sexually transmitted diseases among the ASGM operators and their workers.
m) The use of hard drugs, alcohol, and local illicit brews has been reported in these areas which are thought to be the drivers of most of the social vices.

n) The local authority Kadoma Rural District Council has failed to collect mining royalties from these ASGM operators, which should be used in local infrastructure development.

o) There are also frequent running battles reported, with the ZRP and the special gold squad that enforces laws around gold mining and selling. The ASGM players do not seem to want to abide by the laws as they seem to be a law unto themselves. The army has been called out at times to try and bring sanity to the sector.

p) The sector operates mostly without EMA Licences such as the prospectus and full EIA

q) They do not supply appropriate personal protective equipment (PPE) to protect the safety of their employees who will be working with inadequate tools and equipment and most of them use homemade tools which turn out to be quite dangerous during use.

r) The mining areas lack adequate sanitation and there is extensive open defecation which has the potential to attract flies leading to diarrhoeal diseases such as cholera, dysentery, and shigellosis.

5.2. THE RECOMMENDATIONS

5.2.1 General

Development programs, particularly aimed at stimulating economic activities, should take into account the views of the affected population. This will result in getting first-hand information from those key affected groups.

5.2.2 Recommendations to Academia

Not much has been written about the ASGM activities and their contribution towards economic development, jointly with their contribution towards sustainable development, more research is therefore required in more different settings. As demonstrated by this research, the ASGM sector would be more prosperous when sustainable development is mainstreamed throughout all activities. Research is very beneficial to many Districts as it contributes to the stock of knowledge as well as in availing solutions to the challenges encountered in the economic processes. The current research has revealed too many gaps in theory and practice, in which the academia can assist with research to determine appropriate solutions.

5.2.3. Policy/ Governance Recommendations

The study findings showed that there is a significant relationship between gold production and its contribution towards sustainable development of the local areas by the small-scale gold mining operators. The policy recommendations are that:

- The government departments must enforce existing legislation that relates to gold production and sustainable development in the local areas.
- The institutions that are mandated to propagate, roll out, and evaluate policies must come up with relevant and appropriate policies that promote sustainable development in the ASGM sector.
- These institutions need to strengthen their policies as well as heighten implementation: EMA, ZRP, MoMMD, RDCs, Fidelity, and NSSA.
- Genuine and legitimate alliances driven by the ASGM operators, not opportunists must mobilise membership within the context of the prospective policy framework for ease of information dissemination and implementation of training programmes.
- Membership in these groups can also be fully supported by the Ministry of Mines and Mining Development with collective access to technical knowledge and resources.

- The continued absence of a statutory legal framework that constitutes a policy instrument that regulates and administers the ASGM sector to be managed in a sustainable development-oriented architecture is risky and a potential time-bomb.

5.2.4. Recommendations to the ASGM Sector

The study findings have shown that there are many and diverse determinants for gold production contribution towards sustainable development of the area and if a turnaround is to be realised it is imperative for the following to be upheld by the ASGM operators:

- Mine Ministry and ASGM Operators need to understand the meaning and spirit of sustainable development.
- ASGM operators need to understand that they cannot take away the full value of the gold produced for their direct use but that part of it needs to be invested in the local community.
- ASGM Operators need to understand that mining is unattainable if done unsustainably.
- Investment in corporate social responsibility.
- Digital Technologies can increase both productivity and sustainable development.

- Take local people for employment in the mines.
- Cultivate own competency.
- Acquire and use proper mining tools.
- Supply appropriate and adequate employee safety protection from mining hazards.
- Reclaim the pits that the mining process has created.
- Respect the rights of other people.
- Commit to own obligations.
- Become a good corporate citizen in the area in which they operate in.
- There is need for the owners/managers to be responsible and accountable for their activities.
- They must adhere to the requirements of the law and to the local community's expectations.

5.2.5 Recommendations on the Application of the author's Own Model

The model which was developed as a mimicry of reality in the ASGM sector while projecting a potential deliverable for VISION 2030 Upper Middle-Income Society, can be applied to analyse the impact of general mining economic activities on the development of local areas in line with local socio-economic and environmental protection objectives such as the following:

- Creating a winning formula for the whole mining sector, particularly the ASGM operators
- Seriously engaging the local communities in which the gold mining is taking place
- ASGM players need a certain level of competency to appreciate the technical, social, and economic thrust of their ASGM activities. It should not be just mining and getting gold and selling it to get money but there is more that needs to be appreciated such as the fulfilment of sustainable development goals in which the operators must balance their economic, environmental and social goals.

- The model attempts to provide both hard and soft sides to the ASGM challenges in terms of the skills, cultural connotations, spirituality, off-spring, Ubuntu philosophy, future generations, satisfying national 2030 goals, safety, and health needs at the employee and community levels.

- The model places digital technology at the centre for disaster and rescue services communication, coordination, geophysical profiles.

- The model presents all quasi-agencies, Government Ministries, and Departments into a coordinated and accountable ecosystem

5.2.6 Recommendations Towards the Study Area

The area of small-scale gold mining and its potential to fuelling sustainable development does not seem to be well appreciated by the ASGM players and the local community. The roles of each of these stakeholders need to be clearly defined and enshrined in a piece of legislation for purposes of enforceability of rights and obligations by all parties concerned. Currently, the ASGM operators ex-pect the government to close off all the mined pits that they created. The local community assumes that the ZRP must enforce rules to do with reclamation and rehabilitation to ensure that their areas are safe for their children and animals. The extent to which the local community must benefit from the locally available natural resources must also be defined. The local leadership and local communities have stepped aside and left the MoMMD to deal with the challenges associated with the activities of the ASGM operators as they cite the strong mining Act which is said to supersede all other pieces of legislation. Kadoma district is host to large-scale mining companies and research can be undertaken on how the two categories can create linkages that can be used for learning and skills transfer purposes based on a mentor (large-scale mining companies) and mentee (small-scale mining operators ASGM operators included) system.

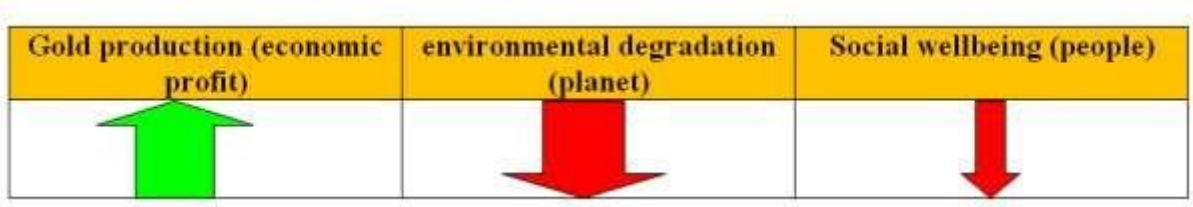
5.3. CONCLUSION

5.3.1 General

The study found that there are huge gold outputs in the various mining areas within Wards 14-16 in the district. However, there is no contribution towards sustainable development in the local area. There is extensive degradation of the local environment. There is no balance among the three pillars as shown in the following diagram

District

Figure 5. 1: Status of the SD Pillars in the Wards 14-16 Area of Kadoma



Source: Scholar's Own Construction (2024)

There is gold production (economic motivation and profit) in the area however there is extensive environmental degradation (no reclamation or rehabilitation of the degraded areas), in addition to poor social well-being (failure to enhance local people's lives).

5.3.2 Conclusion Based on Objectives

The study established that there were several small-scale gold mining activities in the Kadoma District Wards 14-16. These artisanal small-scale gold mining activities are characterized by few employees (Zvarivadza, 2018). They are limited to the mining of mostly gold using rudimentary methods. The study further looked at the small-scale gold mining activities in terms of legal compliance, social licence, local development, and sustainable development, which is a departure from using only economic development variables such as employment (Hawkins, 2000).

The study concluded that there was good gold production however this was not supporting local sustainable development as evidenced by extensive environmental degradation, and an integrated model that seeks to tame the ASGM effects and strategies in a smart architecture.

Objectives:

The Kadoma District Wards 14 - 16 area has very rich gold deposits that lend themselves to mining with basic crude mining methods. That the area is rich attested by the types of cars that visit the area, the number of illegal gold buyers, and the high presence of ZRP Officers. The country has set a target of $ 12 billion and in the past two years, the largest contribution has been delivered by the ASGM players, who have been reported to have injected more than 60% into the RBZ coffers. This performance has been despite the huge gold leakages in which these ASGM players sell to middlemen who likely smuggle the gold outside the country. There has not been any contribution by the ASGM players towards the sustainable development requirements of the area. The area is currently extensively degraded, with open

pits, devoid of any vegetation, both trees and grass. The biodiversity of the area has been disturbed with most wild animals in a non-existent state due to poaching and destruction of their habitat.

There are several challenges that the ASGM is facing and these include the following:

- operators' lack of competency in proper mining methods
- lack of resources such as access to adequate mining equipment and tools
- continuing to utilise old mining and mineral processing technologies such as manually digging the ore, use of mercury in picking the gold as well as other chemicals such as nitric acid
- lack of appreciation of the need to undertake reclamation and rehabilitation of the mined areas which they leave in a state of extensive degradation
  lack of proper methods of surveying for the gold and mostly use very crude methods which are inefficient
- engaging in illicit drugs and local brews which cause them to become unruly leading to machete fights which have led to loss of life and serious injuries. It has on many occasions sucked in the local community members.
- engaging in running battles with the ZRP and Ministry of Mines and Mining Development as well as by EMA due to their failure to regularise their activities with the regulatory authorities.
- operating with minimum papers from the Ministry of Mines as well as from EMA. They also seem to be reluctant to formalise their activities lest they are spotted and are required to pay to NSSA and ZIMRA which they do not appreciate.
- lack of social licences in which they can create good relations with the local communities and contribute to paying royalties to the RDC for use in local development programmes such as road infrastructure.
- The ASGM operators go into the mining sector with little competency and inefficient gold production strategies. They lack know-how in better mining methods,

- lack tools and equipment which are fit for the job as they mostly use homemade tools and equipment.
- not attend training workshops whenever they are organised by the Ministry of Mines and Mining Development.
- lack of appreciation of the need for sustainable development pushing everything as the responsibility of the government
- Whereas the use of mercury was banned, the ASGM sector continues to employ it thus exposing their workers to carcinogenicity and in addition causing surface and groundwater pollution from the mercury leakages.

5.3.3. Conclusions Based on the Research Proposition

This section gives conclusions based on the research proposition stated in Chapter One. See already discussed conclusions based on the research proposition.

5.3.4. Conclusions Based on Own Model

The effects of the ASGM activities on the sustainable development model provide a robust analytical framework for evaluating the contribution of small-scale gold mining. This framework is also applicable to other economic sectors, offering broader insights into their impact on sustainable development.

5.4 DISCUSSION ON THE RESEARCHER'S OWN MODEL

The researchers' model was developed in line with the DPSIR framework *(Driving Forces – Pressures – State – Impacts – Responses* (DPSIR) framework). Although the framework was initially used in monitoring the environment, it was adopted by this research which focused on the effect of mining on sustainable development. The model is adaptable in various business and operational contexts to assess the consequences of economic activities such as in the ASGM sector. Two distinct variables for the study are illustrated, that is gold production on the first hand whilst the other is pitted against the sustainable development undertaking. Gold production has been discussed in terms of its main drivers, its nature, and extent and how it could be used to effect sustainable development in the local affected areas.

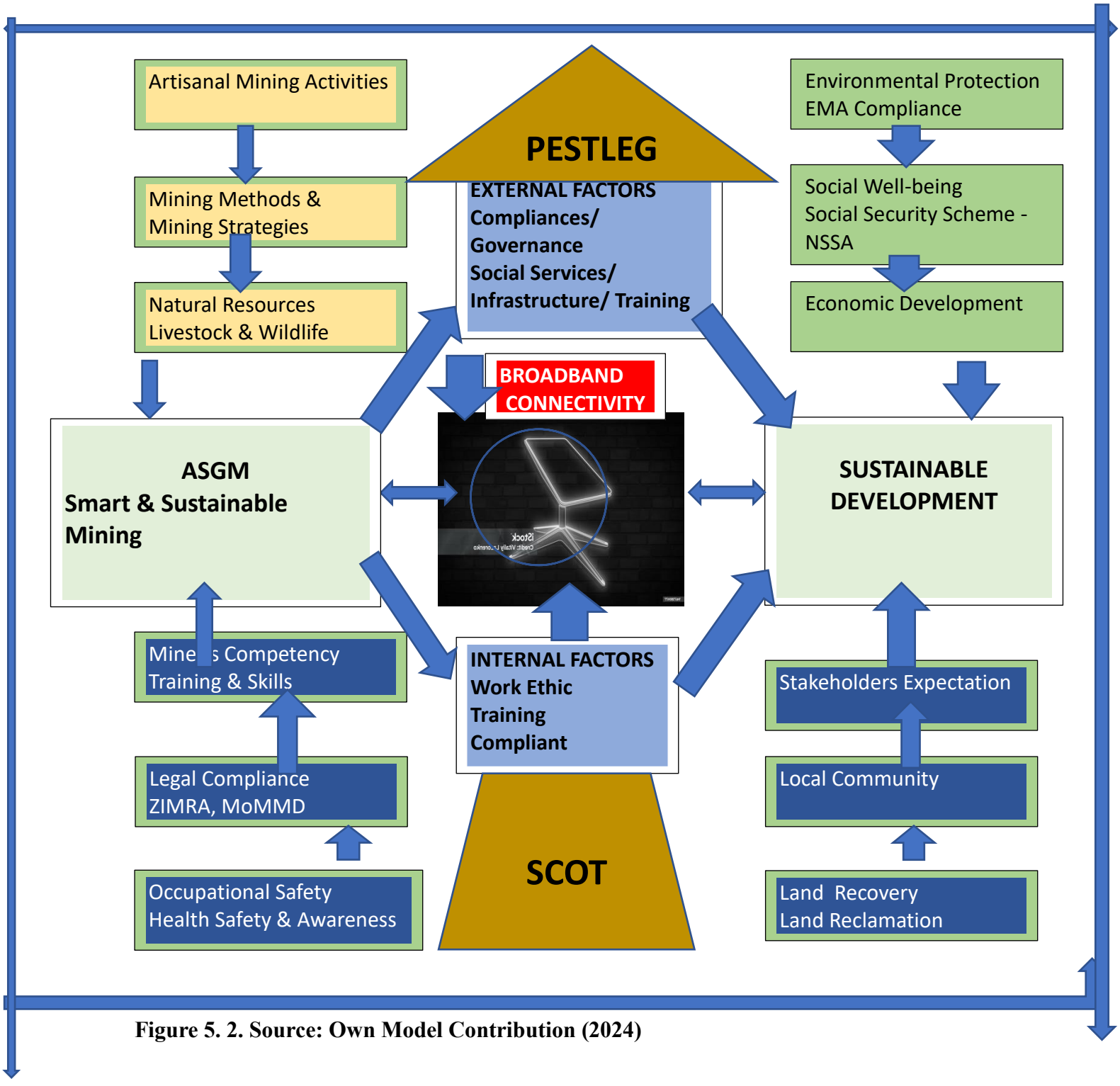


Figure 5. 2. Source: Own Model Contribution (2024)

Therefore, to emphasise its usefulness in development, it was necessary to discuss its main drivers as postulated by the DPSIR framework.

According to the USEPA (2015), "the modern problems (e.g., pollution, urban sprawl, environmental equity) are complex and often transcend spatial and temporal scales. Scientific research and decisions are frequently limited to a particular economic concern,

level of authority, or scientific field and therefore address a single aspect of a problem with insufficient understanding or consideration of short- and long-term consequences to the larger system. Additionally, stakeholders and decision-makers frequently implement multiple, uncoordinated management actions. While each of these management actions may be successfully implemented for a particular purpose, the combined effects may not lead to improved environmental conditions".

Whilst gold production is set to continue impacting positively on the economy, leakages need to be closed and formalisation can align many of these operators with the requirements of all key stakeholders. With improved methods, artisanal mining can increase in the scale of operations, and there can be the adoption of better mining methods to exploit the natural resources in balance with the sustainable development needs of society, environmental protection, and catering for societal needs through royalties and local employment opportunities offered by these ASGM operators. Both internal strengths, challenges, opportunities, and threats, (SCOT) and external political, economic development, sociological, technological, legal, environmental, and government, (PESTLEG) factors can act as interfering, moderating, and enhancing variables depending on the level of production, and discipline.

5.5. SUGGESTED AREAS OF FURTHER RESEARCH

Research can be further focused on a variety of issues that are encountered in the ASGM sector which also have implications on socio-economic impacts. These may include research on the impact of ASGM on women and the youth, studies on increasing productivity, leakages, and enhancing efficiencies in the small-scale gold mining sector. For instance, research cn address the issue of entrepreneurship among the small-scale miners. Studies can also look at the role of local authorities on mineral-led development in their local areas and communities.

5.6. THE LATEST DEVELOPMENTS IN THE STUDY AREA

The Government of Zimbabwe has enacted the National Development Strategy 01 and the mining sector is set to contribute USD12 billion towards the fiscus. This is aimed at guiding mining development for the period through to 2030.

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BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

GRADUATE SCHOOL OF BUSINESS

MASTERS IN BUSINESS LEADERSHIP AND CORPORATE GOVERNANCE

1st April 2024

Dear Respondent

REF: A LETTER OF INTRODUCTION AND/OR INVITATION TO PARTICIPATE IN THE RESEARCH INTERVIEW

I, Langaton Mabhanga, ID No. 24-085921 Y 13, am a final year student at the Bindura University of Science and Education Graduate Business School, Student Number B230176A. I hereby introduce myself to you/ request you, in your official capacity, to participate in exclusively academic research entitled: **A Smart Architecture for Sustainable Development of the Artisanal and Small-scale Mining in the Kadoma District.**

Please note all your responses will only be used for academic purposes only and will be anonymous, with no intention to attach these to your person, nor seek to record these for any form of incrimination. While your responses will be of academic importance, there will not be any stipend or compensation due to yourself for completing the interview. This is taken voluntarily and will forever be as such. While we encourage full participation in all the questions presented to you, please feel free to skip any question you deem uncomfortable to you.

To the regulatory, marketing, and Government Departments, please kindly revert to the undersigned with your your availability slots.

Thanking for your participation and co-operation.

Yours Sincerely

Langaton Mabhanga
+263 77 231 7793 | langton@africatruenorth.com |



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RESEARCH INTERVIEW GUIDE – APPENDIX A

Sex: F/M **Age:** Less than 20 | 20-30 | **Experience**: 5-10 | 11-15| 1 6-20 | Above 21

District of Residence: Kadoma District | Out of Kadoma Do you own the mine claim: **Y/N?**

4. What are the causes and impact of artisanal mining on sustainable development in Kadoma District?

4.5. How are long have you been mining?

4.6. What motivated you to consider artisanal mining and do you have any formal training?

4.7. Do you have title to the mine claim you are working on?

4.8. Are you aware of practice any land, people, environment and livestock conservation during mining? Elaborate

4.9. Describe the biggest environmental incident that has ever happened and whether there were any interventions / formal report?

4.10. Describe the existing general demography and any social services, facilities, challenges, and interventions.

4.11. What sort of effect has the artisanal mining had on your personal economy and local economy

4.12. Describe how the mined gold is transacted?

5. What are the strategies used in ASGM in Kadoma District?

5.5. How do you identify gold deposits, mine and extract the gold?

5.6. How do you develop the mine pits/ shafts/ tunnels and anchor the roof supports?

5.7. What are the hazards and incidents that have been incurred in the operation and are associated with the artisanal operations?

5.8. What is the extent of participation or disjuncture with the local community and why?

5.9. What is the extent of interaction between the ASGM operators and the law enforcers and regulators?

5.10. What is the economic infrastructure that the operators leverage for productivity? Elaborate how this is secured, maintained and sustained?

5.11. In the course of your operation, do you see the environment, infrastructure and people a consideration ahead of your mining?

6. What is the smart architecture for sustainable development in ASGM?

6.5. What improvements do you perceive as helpful to your operation

6.6. What do you reckon would be the most optimum interventions to mitigate adverse conditions? Describe the conditions.

6.7. Describe any deemed systemic prejudices.

6.8. Is there any additional information to share?