

**BINDURA UNIVERSITY OF SCIENCE EDUCATION**



**DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**Circular Economy and Waste Management in Zimbabwe: A Case for The Mining Sector**

**CHIEDZA CHIBHANGUZA**

**B225247B**

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN  
SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT.**

**May 2025**

## Approval Form

We, the undersigned do hereby certify that we have supervised, read and therefore recommend to Bindura University of Science Education for acceptance; a research project titled ‘Circular Economy and Waste Management in Zimbabwe: A Case for The Mining Sector’ in partial fulfillment of the requirements of the Bachelor of Science Honors Degree in Safety, Health and Environmental Management.

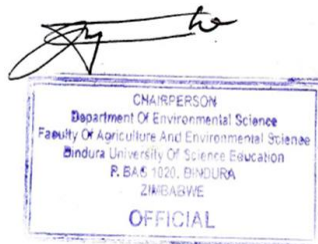
### Supervisor



.....

**Date. / 31 May 2025**

### Chairperson



**Date: 31 May 2025**

### signature of student



.....

**Date 31 May 2025.**

## **Dedication**

To my family, my greatest fountain of support. This beautiful work is for you. Thank you...

## **Acknowledgement**

Successful completion of this beautiful project would not have been possible without guidance of my supervisor Dr. V. Dudu. Throughout every part of the project, her skills, expertise, and constant feedback helped to shape this work.

My family has also been a part of this journey; they stood by me from the start. It could not have been possible without you all. Your deepest inspiration was not only amazing but profound as well...I am beyond words to express the feeling. I will remain appreciative!

## **Abstract**

The broad aim of the study was to explore the benefits of adopting circular economy in waste management in the mining sector for Zimbabwe. Premised on three objectives, this qualitative study used a systematic review of literature resulting in four thematic areas of analysis. These are; significance of mining sector to the economy of Zimbabwe, barriers to circularity, drivers of circularity in waste management for the mining sector as well as policies to enhance circularity. In the findings, major barriers identified include; technology constraints, weak role of government as well as lack of collaboration in the circular economy ecosystem. The study argues that attaining the USD 12 billion target by the Government of Zimbabwe is a target which is possible, accordingly circular economy can contribute a long way to this aspiration. Major policy implications identified in the study underscore the significance of the role of government, capacity building of lobby groups such as Chamber of Mines, reduction of cost of doing business across the economy and others. The study also avows that the entry point for circularity of waste management in Zimbabwe's mining sector should put strong emphasis on initiatives such as recycling, reuse, and regeneration. This is so since major mining concerns in the country have made some progress towards this direction.

**Key Words: Circular Economy, Mining, Waste management, Zimbabwe**

---

## Table of Contents

|                                                                |     |
|----------------------------------------------------------------|-----|
| Approval Form.....                                             | i   |
| Dedication .....                                               | ii  |
| Acknowledgement .....                                          | iii |
| Abstract .....                                                 | iv  |
| Abbreviations.....                                             | ix  |
| CHAPTER 1 .....                                                | 1   |
| INTRODUCTION .....                                             | 1   |
| 1.0 Introduction.....                                          | 1   |
| 1.1 Background to study .....                                  | 2   |
| 1.1.1 Operationalization of the Mining Plan in Zimbabwe.....   | 3   |
| 1.1.2 Waste Generated in the Mining Industry in Zimbabwe ..... | 3   |
| 1.2 Problem Statement.....                                     | 6   |
| 1.3 Aim of the study.....                                      | 6   |
| 1.4 Objectives of the study.....                               | 6   |
| 1.5 Significance of the study.....                             | 7   |
| 1.6 Limitations of the study .....                             | 7   |
| 1.7 Delimitation of the study .....                            | 7   |
| 1.8 Organisation of the study .....                            | 8   |
| CHAPTER 2 .....                                                | 9   |
| LITERATURE REVIEW.....                                         | 9   |
| 2.1 Theoretical Literature Review .....                        | 9   |
| 2.1.1 Linear Model of Economy .....                            | 9   |
| 2.1.1.1 Characteristics of Linear Economy Model .....          | 9   |
| 2.1.2 Circular Economy Model.....                              | 9   |
| 2.1.2.1 Characteristics of Circular Economy Model .....        | 9   |
| 2.2 Empirical Literature Review .....                          | 10  |
| 2.2.1 Circular economy and development.....                    | 10  |

|                                                                       |    |
|-----------------------------------------------------------------------|----|
| 2.2.2 Drivers of circularity in an economy.....                       | 11 |
| 2.2.3 Circularity and national policy development .....               | 11 |
| 2.2.4 Barriers to implementation of circular economy.....             | 11 |
| 2.2.5 Circular Economy and Sustainability.....                        | 12 |
| 2.2.6 Collaboration of different stakeholders .....                   | 12 |
| 2.3 Existing Research Gap in Literature .....                         | 12 |
| 2.4 Conceptual Framework.....                                         | 13 |
| CHAPTER 3 .....                                                       | 14 |
| RESEARCH METHODOLOGY.....                                             | 14 |
| 3.0 Introduction.....                                                 | 14 |
| 3.1 Research Design for the Study.....                                | 14 |
| 3.1.1 Samples units used in the study .....                           | 14 |
| 3.1.2 Literature used in the study .....                              | 14 |
| 3.2 Data Sources .....                                                | 17 |
| 3.3 Data Collection and Variables.....                                | 17 |
| 3.3.1 Data Collection.....                                            | 17 |
| 3.3.2 Variables for the study.....                                    | 17 |
| 3.3.3.1 Government .....                                              | 18 |
| 3.3.3.2 Private sector .....                                          | 18 |
| 3.3.3.3 Academia .....                                                | 18 |
| 3.3.3.4 Infrastructure .....                                          | 18 |
| 3.3.3.5 Technology .....                                              | 18 |
| 3.3.3.6 Role of economic clusters.....                                | 18 |
| 3.3.3.7 Sustainable industries .....                                  | 18 |
| 3.4 Data Analysis .....                                               | 18 |
| 3.5 Limitations of the study .....                                    | 19 |
| 3.5.1 Data availability .....                                         | 19 |
| 3.5.2 Time and Financial Resources availability.....                  | 19 |
| 3.5.3 Generalizability .....                                          | 19 |
| CHAPTER 4 .....                                                       | 20 |
| PRESENTATION OF RESULTS .....                                         | 20 |
| 4.0 Introduction.....                                                 | 20 |
| 4.1 Significance of mining to Zimbabwe’s economy .....                | 20 |
| 4.2 Drivers of circularity in waste management for mining sector..... | 21 |
| 4.2.1 Role of government in promotion of circularity .....            | 21 |

|                                                                                             |    |
|---------------------------------------------------------------------------------------------|----|
| 4.2.2 Infrastructure .....                                                                  | 21 |
| 4.2.3 Private Sector participation in circularity.....                                      | 22 |
| 4.3 Barriers in implementation of circularity in waste management for mining sector .....   | 23 |
| 4.3.1 Nascent nature of circular economy.....                                               | 23 |
| 4.3.2 Technical constraints .....                                                           | 23 |
| 4.3.3 Weak legislation and enforcement .....                                                | 24 |
| 4.4 Opportunities for implementing circularity in waste management for mining sector .....  | 24 |
| 4.4.1 Recycling and reusing in the mining sector .....                                      | 24 |
| 4.4.2 Digitalisation of mining technologies .....                                           | 25 |
| 4.4.3 Scrap metal .....                                                                     | 25 |
| CHAPTER 5 .....                                                                             | 27 |
| DISCUSSION OF FINDINGS .....                                                                | 27 |
| 5.0 Introduction.....                                                                       | 27 |
| 5.1 Discussion of Major Themes in the Study .....                                           | 27 |
| 5.1.1 Significance of mining to the Zimbabwean economy.....                                 | 27 |
| 5.1.2 Opportunities for implementing circularity in waste management for mining sector..... | 27 |
| 5.1.3 Digitalisation of mining technologies .....                                           | 28 |
| 5.1.2 Drivers of circularity in waste management for mining sector .....                    | 28 |
| 5.1.3 Barriers in implementation of circularity in waste management for mining sector ....  | 29 |
| CHAPTER 6 .....                                                                             | 30 |
| CONCLUSION AND RECOMMENDATIONS .....                                                        | 30 |
| 6.0 Summary .....                                                                           | 30 |
| 6.1 Conclusion .....                                                                        | 30 |
| 6.2 Recommendations.....                                                                    | 31 |
| 6.2.1 Role of government.....                                                               | 31 |
| 6.2.2 Awareness on the value of circularity in waste management for the mining sector ...   | 32 |
| 6.2.3 Collaboration of different stakeholders in the circularity ecosystem.....             | 32 |
| 6.2.4 Role of technology .....                                                              | 32 |
| 6.2.5 Capacity building of lobby groups .....                                               | 32 |
| 6.2.6 Cost doing business.....                                                              | 32 |
| 6.3 Entry points for circularity in waste management in the mining sector for Zimbabwe .... | 33 |
| References.....                                                                             | 34 |
| Appendix.....                                                                               | 37 |

## **List of Figures**

|                                                       |    |
|-------------------------------------------------------|----|
| Figure 1: Mine dump waste.....                        | 4  |
| Figure 2: Mining Value Chain and Waste Generated..... | 5  |
| Figure 3: Mashaba mine dump.....                      | 5  |
| Figure 4: Key pillars of a Circular Economy.....      | 10 |
| Figure 5: Conceptual Framework.....                   | 13 |

## **List of Tables**

|                                                                                   |    |
|-----------------------------------------------------------------------------------|----|
| Table 1: Contribution of Mining Sector to Gross Domestic Product of Zimbabwe..... | 2  |
| Table 2: Summary of literature systematically reviewed.....                       | 15 |
| Table: 3 Comparative tariff schedule SADC region.....                             | 22 |

## **Abbreviations**

|         |                                                                   |
|---------|-------------------------------------------------------------------|
| ABTC    | American Battery Technology Company (ABTC)                        |
| CE      | Circular Economy                                                  |
| EMA     | Environmental Management Agency                                   |
| FDI     | Foreign Direct Investment                                         |
| GoZ     | Government of Zimbabwe                                            |
| GDP     | Gross Domestic Product                                            |
| IMF     | International Monetary Fund                                       |
| NTDPOZ  | National Trade Development and Promotion Organisation of Zimbabwe |
| ZIDA    | Zimbabwe Investment and Development Agency                        |
| ZIF     | Zimbabwe Institute of Foundries                                   |
| ZIMSTAT | Zimbabwe National Statistical Agency                              |

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Circular Economy (CE) means different things to different people (Kirchherr et al., 2017) and has thus become common parlance in different circles. Geissdoerfer et al., (2017) submit that the term has gained traction among academics, industry as well as policy makers. Further, Kirchherr et al., (2017) make an analysis of literature which has focused on discussions around the concept of CE. In the scholarly literature they review they thus come across over one hundred and fourteen definitions of CE concepts. What then is Circular Economy given so much interest it has generated?

Circular Economy is a systems solution that tackles challenges like climate change, biodiversity loss waste and pollution (Ellen MacArthur Foundation, 2013) On the other hand, European Parliament News (2023) highlights that circularity has to do with production and consumption. All these activities take place in the economy at various stages from production up to the last loop. In addition to the definitions just outlined, Geissdoerfer et al., (2017, p.) define circular economy as:

...a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling

The major purpose of circular economy is to enhance sustainability of resource use through reuse, recycling and extending product lifecycle (Godfrey, 2021). Similarly, PwC (2021) submits that through circularity, economic activity is decoupled from consumption. The purpose being to close the 'loop'.

### *Circular Economy, Waste Management, and the Mining Industry in Zimbabwe*

In 2023, Government of Zimbabwe (GoZ) through the Ministry of Mines set an ambitious target of a USD 12 billion mining industry. This is a very welcome development. The message is clear about the role mining should play as a mainstay of the Zimbabwean economy. Mining activities generate a lot of waste which pose a threat to humans, plants as well as wildlife. In fact, the carnage inflicted on the environment calls for awareness of the need to also reduce wastage in this sector, thus serving the environment a lot.

If Zimbabwe embraces circularity, then will be protection of biomass loss, reduction of exploitation of natural resources, reduction of Green House Gases (GHGs) and protection of the natural landscape as other low hanging fruits. This comes at a time when countries the world over are making efforts to reduce problems such as emissions. These impact the environment through depletion of the ozone layer.

How then to package circularity in waste management for the mining industry in Zimbabwe? This is the most important question. Is the level of awareness adequate enough of the immense benefits of circularity? What are the experiences in other contexts? Are there adequate policies to promote circularity in Zimbabwe in general? Specifically, is the mining sector ready to embrace circularity with respect to waste management? If so, what are the gains from circularity specifically in the mining sector's waste management?

### 1.1 Background to study

The mining sector is one of those pillars of economic growth To the Zimbabwean economy, application of circularity w. It has always contributed significantly to the Gross Domestic Product (GDP). The following table shows the trend with respect to GDP contribution of mining from 1980-2008.

**Table 1: Contribution of Mining Sector to Gross Domestic Product of Zimbabwe**

| Period    | Average annual mining exports (USD millions) | GDP growth rate p.a (%) | Mineral exports share in comparison to total exports (%) |
|-----------|----------------------------------------------|-------------------------|----------------------------------------------------------|
| 1980-1988 | 533                                          | -2.5                    | 41.2                                                     |
| 1990-1999 | 629                                          | -1.8                    | 32.3                                                     |
| 2000-2008 | 720                                          | 5.6                     | 40.4                                                     |
| 1980-2008 | 564                                          | 1.3                     | 37.8                                                     |

**Source: Mahonye and Mandishara (2015).**

The table also shows that the growth of the sector has largely been subdued. The highest growth was realized from 2000-2008 with a 5.6 % growth rate per annum. The corresponding receipts for the same period were USD720 million. This represents great potential for the country.

In Zimbabwe, mining has been recognized as one of those pillars to spur growth and development of the local economy in addition to agriculture and manufacturing. The government of Zimbabwe through the Ministry of Mines unveiled an ambitious plan to achieve a USD 12 billion mining industry (The Herald, 2023).

### **1.1.1 Operationalization of the Mining Plan in Zimbabwe**

To fully realize the contribution of the Mining Sector to the economy of Zimbabwe, several strategies are being considered by the government. These are:

Skills investments through institutions such as the School of Mines

- ✓ Open of business mantra has seen increased Foreign Direct Investments in mining
- ✓ Banning of exports of raw minerals such as platinum and lithium among others.
- ✓ Increase in retention forex to exporters.
- ✓ Incentives to critical constituents such as gold producers.

All the above strategies are important for the industry as it aspires to achieve a USD 12 billion target. This is important for generating the much-needed foreign currency as well as jobs among other benefits. However, the strategy can also be complemented by considering adoption of circularity in terms of waste management generated in the sector.

The above proposed plan is mute on the role circularity targeted at waste management can play for the economy of Zimbabwe. Thus, this study is also a clarion call to also raise awareness on the importance of circularity in waste management in Zimbabwe's mining sector.

### **1.1 .2 Waste Generated in the Mining Industry in Zimbabwe**

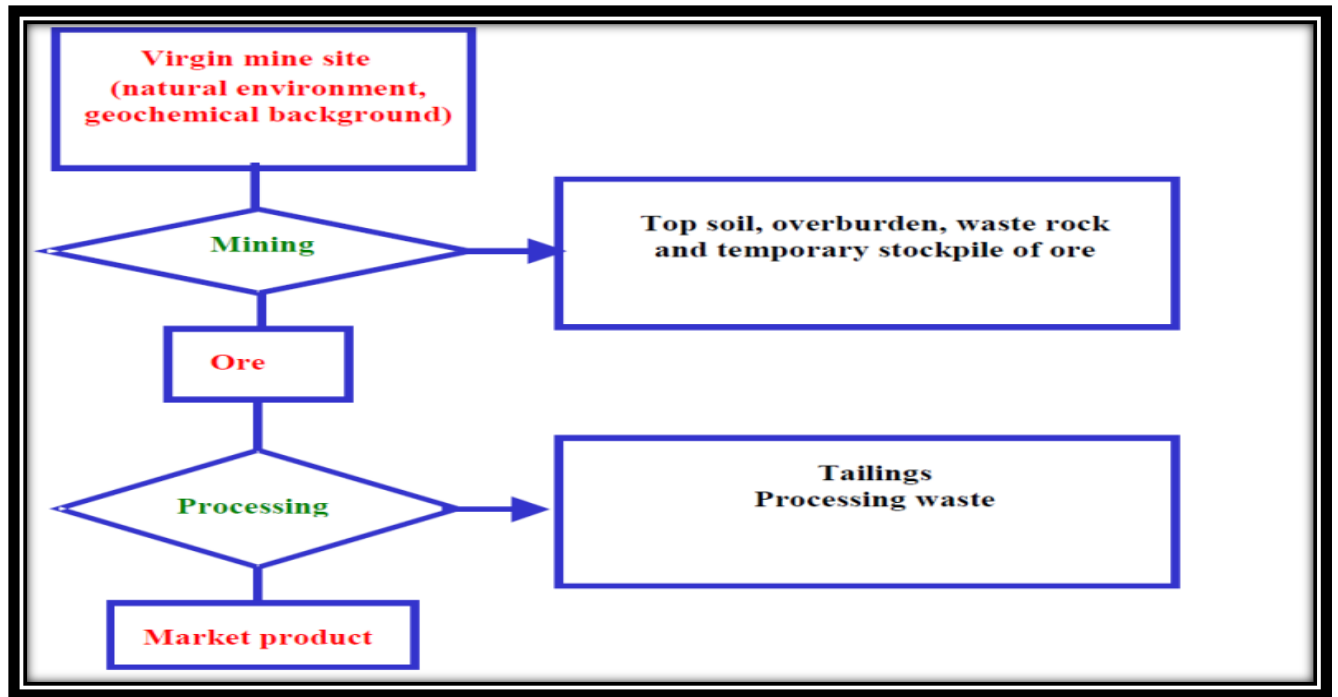
Mining operations generate a lot of waste. Some waste is useful whereas some is harmful to people as well as the environment. Figure 1 below shows mine dump waste.



**Figure 1: Mine dump waste. (Source: SGU)**

In fact, Kalisz et al., (2022) show that mining generates over 65 billion tonnes in terms of waste. This on its own poses challenges in terms of how to properly dispose of it as well as maintaining harmony with the environment. For instance, mining also produces various products such as iron and steel and related metals. Later, these become scrap metal due to wear and tear which when discarded only becomes waste. Reports show that for scrap metal, Zimbabwe loses USD 1.5million annually through smuggling (The Zimbabwean Mail, 2023).

Mining through its various activities at different stages does produce waste of different types shown in the Figure 2 below.



**Figure 2: Mining Value Chain and Waste Generated (Source: Manyuchi et al., 2019)**

Figure 2 shows the various activities involved in the mining value chain and the respective waste generated at the different nodes. For instance, tailings are waste which is generated by the mining industry during processing. These can be silty material generated from recovered ore through various mining processes. It is important that they are disposed off properly or they can be reused further for other processes like raw materials in production of cement and other important materials. On the other hand, the actual extraction produces top soil burden, waste rock as well as temporary stock pile. A good example of waste burden from mining is that from Mashaba Asbestos mines as shown below;



**Figure 3: Mashaba mine dump (Source: Tavingeyi, 2017)**

Mining processes use huge volumes of water which sometimes can become contaminated. Waste mine water is also waste generated through various mining processes. It is important that it is released to the environment properly as it may be harmful if not properly disposed. Additionally, it can be recycled and reused through mining processes again.

## **1.2 Problem Statement**

The mining industry of Zimbabwe has a potential to generate USD 12 billion target through various strategies such as investments, incentives, among others. However, not much is said of the potential contribution of adapting circular economy for waste management in the mining industry as a sustainability strategy to compliment the current initiatives. Through creation of value addition, recycling and reusing of waste for instance, the mining industry of Zimbabwe can be transformed. Through circularity of waste management in this sector, the USD 12 billion mining industry is much more attainable. Circularity will help generate extra jobs, generate revenue to the fiscus, efficient resource recovery and reduction of waste, longevity of usage of resources among other potential benefits. This study therefore attempts to locate how circularity can be adopted for waste management in the mining industry of Zimbabwe. This goes a long way in complementing other strategies the Government of Zimbabwe has put in place so as to enhance the sector.

## **1.3 Aim of the study**

The broad aim of the study is to explore the benefits of adopting circular economy in waste management of the mining sector of Zimbabwe.

## **1.4 Objectives of the study**

The objectives of the study are to:

1. Examine the benefits of adapting circular economy in waste management for the mining industry of Zimbabwe.
2. Investigate the challenges of adapting circular economy in waste management for the mining industry of Zimbabwe.
3. Examine actionable policies of enhancing circular economy in waste management for the mining industry of Zimbabwe.

### **1.5 Significance of the study**

The study is significant to a number of stakeholders in a number of ways. To policy makers with respect to the Government of Zimbabwe (GoZ) the study is very relevant. As alluded earlier, the timing of the study is critical. Circularity of waste management for mining will contribute to government in areas such as revenues and management of the environment.

In Zimbabwe, there is presence of private players in the mining industry such as mining companies, mining associations, they are also set to benefit from the study. They are also able to engage government on how best they can work together in implementing circularity. Areas such as implementation framework of the concept will then be agreed upon through resulting public private partnerships among other models.

The study contributes to existing literature specifically on how circularity can be adopted in waste management for the mining industry. Literature with respect to this field is still budding. Thus, the study will generate debate and motivate further research.

### **1.6 Limitations of the study**

The major limitation of the study is the issue of data. Data availability remains a key challenge. Due to the novelty of the study in the context of Zimbabwe requisite literature still remains scanty. As such, the study also makes use of grey literature.

### **1.7 Delimitation of the study**

So as to make sure that best practices for circularity are incorporated in the study so as to inform waste management in mining in Zimbabwe, several case studies will be used in the current study.

Qualitative research design is adopted for the study. The methodology relevant for this design will be content analysis. It helps us to be able to examine policies in the respective case studies we shall investigate.

## **1.8 Organisation of the study**

Chapter 1 presents the Introduction and background to the study. This includes defining key concepts relating to Circular Economy as is encountered in literature. Further, the chapter gives the context of the current study. This helps to situate the main aim and subsequent objectives of the study. In Chapter 2, Theoretical and Empirical Literature is presented. The overview helps us to be able to identify current gap the study intends to fill. In Chapter 3, Research Methodology is explored. This explains how we intend to answer the objectives of the study including the data sources used. Chapter 4 gives Presentation of Results. In Chapter 5, Discussion of Findings explains the findings obtained in the study. Chapter 6, Summary, Policy Implications and Conclusion will wind up the study as well as answering objective number 3.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Theoretical Literature Review**

The concept of circular economy is still upcoming in most developing countries such as Zimbabwe. However, it has become a topical theme in most emerging markets and the rest of the developed world. Thus, scholarship on this theme is also nascent. This section explores theoretical developments around the concept. This acts as a springboard upon which the current study is based. For any economy, in terms of production, it can either be oriented towards linear or circular as shall be discussed below;

##### **2.1.1 Linear Model of Economy**

This is a traditional model of production in the economy inclined mostly towards a use and dispose approach (Baranski, 2021). MacArthur Foundation (2013) highlights that linear structure is mostly concerned with, ‘Extract-produce-consume–discard’ approach.

###### **2.1.1.1 Characteristics of Linear Economy Model**

Linear model is comprised of the following key distinguishing features

- wastage of resources
- mass consumerism and people are encouraged to consume en masse and absence of feedback loop among manufacturers.

As a result, the linear economy model has an undesirable environment footprint. In the wake of climate change awareness, it becomes very undesirable. When related to the mining sector it even becomes more unwelcome since there is a lot of waste management in this industry.

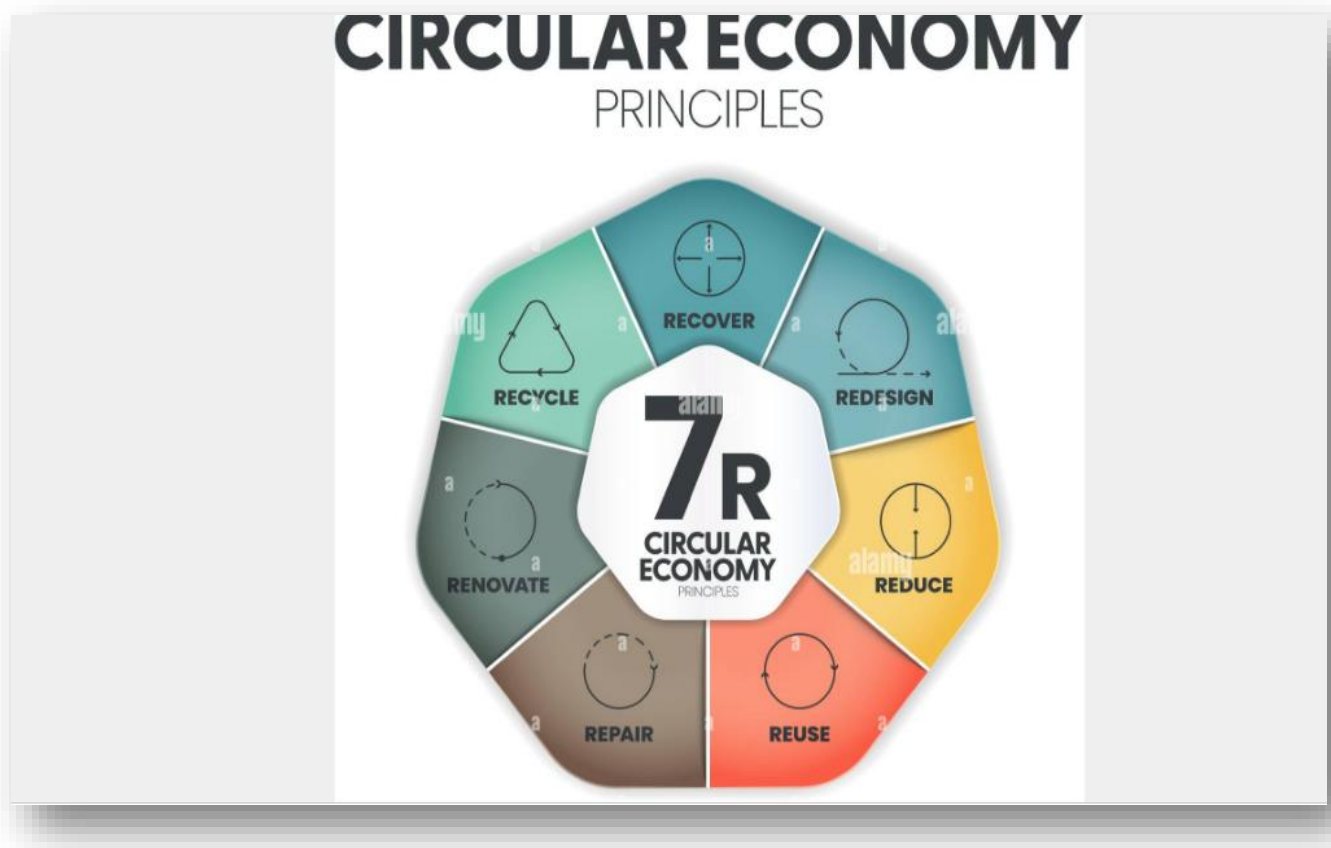
##### **2.1.2 Circular Economy Model**

This is a better option for an economy which emphasizes much more efficient utilisation of resources popularized in the 1990s (Ekins et al., 2020). The authors highlight that CE is a model which is based on two ideas: These are (1) the flow of materials through the economy and (2) economic conditions that might bring such a flow.

###### **2.1.2.1 Characteristics of Circular Economy Model**

- reuse of resources
- closing the loop and feedback into the system.
- Longevity of material use

There are seven key pillars of CE. These are recycle, recover, redesign, renovate, repair, reuse and reduce as shown in Figure 4 below.



**Figure 4: Key pillars of a Circular Economy (Source: Thalang 2022)**

Figure 2 shows that through circularity with respect to waste management, like in the mining sector, there are benefits. These include reduction of environmental footprint; waste minimization; reduction of resource dependency and generation of income.

## **2.2 Empirical Literature Review**

### **2.2.1 Circular economy and development**

Literature shows that CE is increasingly becoming important as it champions development which is in harmony with the environment. It is in essence the next frontier for sustainable growth and development. Godfrey (2021) notes that emerging countries such as Brazil, Russia, India, China and South Africa (BRICS) are making progress in this regard. Godfrey (2021) further shows that through CE, economies are encouraged to save more on resources such as energy as well as preserving the environment through good environmental practices.

Scarpellini et al. (2019) explores circularity with respect to a region in Spain using a qualitative research design exploring efficacy of CE. Major findings show that there are potential factors to hinder effective CE implementation. This includes funding issues to support investments, lack of knowledge and commitment to CE activities among others. However, the authors underscore socio economic benefits to a region because of adopting circularity. These include reducing Green House Gases (GHGs), minimum waste, employment opportunities in CE related jobs as well as regional development.

### **2.2.2 Drivers of circularity in an economy**

Govindan and Hasaganic (2018) in a study of circularity emphasize on the drivers of circularity. The factors they mention include which should be embraced. These include government policies and laws to support development of circularity, as well as support by society CE activities as among examples of drivers that can help sustain CE.

In terms of implementing circularity issues of infrastructure are fundamental for circular economy. The presence of requisite infrastructure be it hard or soft is the backbone of a sector such as mining for it to be able to implement circularity in waste management. In fact, Aggreko (2018) shows that one of the challenges hindering mining is access to energy. In essence it increases the cost of doing business.

### **2.2.3 Circularity and national policy development**

Godfrey (2021) and Aggreko (2018) underscore the importance of adoption of CE policies at national level. Thus, CE ought to be part of development agenda of a modern economy. This helps to ensure sustainability of economic growth. CE has become critical for many developed countries such that it has become an integral component for sustainable development.

### **2.2.4 Barriers to implementation of circular economy**

Govindan and Hasaganic (2018) in Ekins et al., (2019) give a set of barriers they call cluster of barriers in implementation of circularity. These include (1) Governmental – for example, lack of policy support and lack of performance indicators.

- (2) Technological- for example, lack of monitoring product quality throughout lifecycle.
- (3) Knowledge and skills- for example, low level of awareness about remanufactured goods.
- (4) Management issues- for example, lack of support of CE at firm level.

- (5) CE framework issues- for example, over focusing on recycling at the expense of other CE activities.
- (6) Cultural and social issues- for example, negative perceptions about remanufactured goods.
- (7) Market issues- for example, experience and expertise in packaging and marketing CE.

### **2.2.5 Circular Economy and Sustainability**

One other important dimension of circularity found in literature is the concept of sustainability. Given the exploitation of resources and the desire for sustainability economies, sustainability has thus become important. Literature shows that CE can be a way of enhancing sustainability of economies. Scholars such as Halog and Anieke (2021); Gedam et al., (2021) reflect also on the central role circularity can play in resource management.

### **2.2.6 Collaboration of different stakeholders**

Literature shows that for the efficacy of circularity to work in an economy, there is need for coming together of different stakeholders. Halog and Anieke (2021) submit that stakeholders include industry, governments, public as well as academia. All these have various roles they play in ensuring success of circularity in different sectors of the economy. Industry, for example is important in fostering transition into circularity through different areas including new product development as well as adoption and dissemination of technologies. On the other hand, government can help through incentives and necessary regulation in an economy so as to stimulate circularity (Halog and Anieke, 2021).

It is also important to note that the close working relationship of stakeholders in circularity is important. For example, government can bring on board the public importance in ensuring operationalization of circularity in an economy. For instance, through awareness programs, the public can be educated through government driven initiatives on the importance of circular economy. On the other hand, academia can be brought on board to come up with specific training programs on circularity.

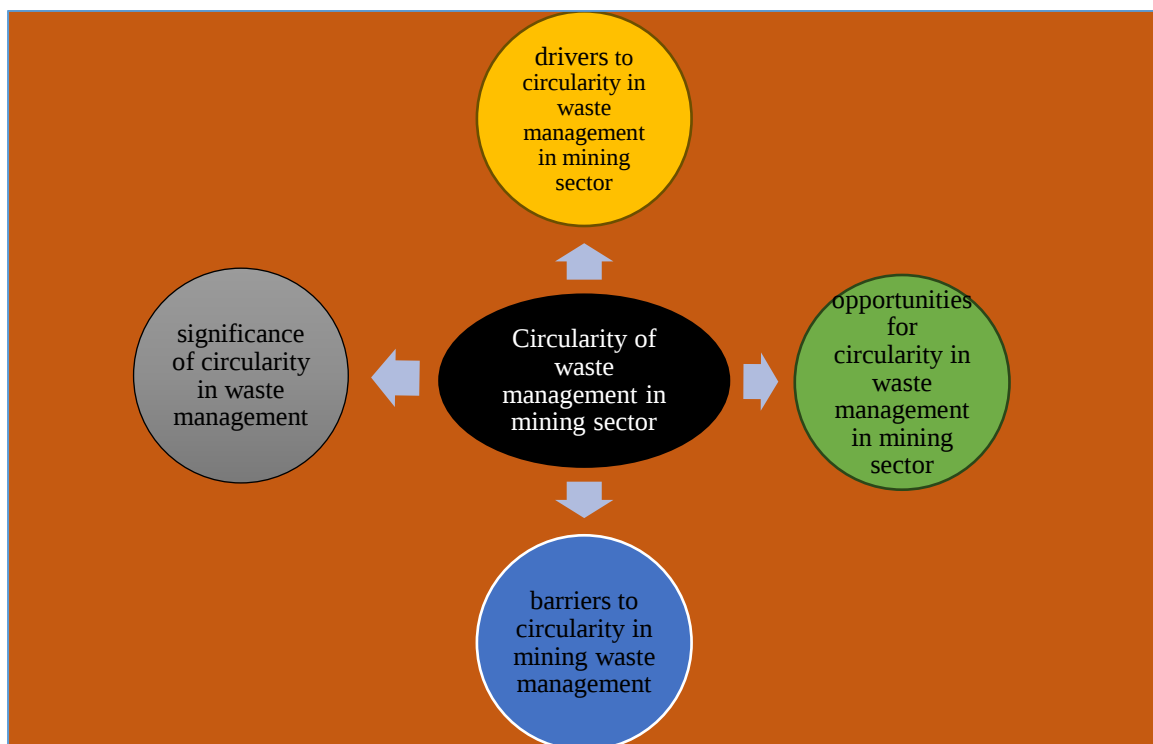
## **2.3 Existing Research Gap in Literature**

In sum, the above empirical literature has explored major thematic areas which we encounter in literature. These include development, national policy, barriers to implementation of circularity and drivers of circularity. Thus, the literature surveyed is very important. It has enabled us to dissect major issues which have been covered with respect to the circular economy as well as mining as an industry. There is however dearth of literature in terms of

how circularity can be related to waste management in the mining industry of Zimbabwe. This is especially so given the USD 12 billion target the country is pursuing. How can we locate circularity in waste management in the mining sector? The literature surveyed is still scanty, this creates a gap the current study will fill.

## 2.4 Conceptual Framework

From the review of literature, we develop a conceptual framework presented in Figure 5.



**Figure 5: Conceptual Framework (Source: Own conceptualisation)**

The above conceptual framework is derived from all the literature reviewed in Chapter 2. Thus, there are therefore five themes- the central focus of this study. In fact, figure 5 is the summary of the key thematic areas to be examined as we locate the theme of circularity in waste management with respect to the mining sector in Zimbabwe. Figure 5 therefore shows all the themes which will be the basis of thematic analysis, the data analysis strategy for this qualitative study.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.0 Introduction**

This chapter presents a detailed description of research design adopted for the study used for answering the objectives of the study. Further, it also gives the steps followed as well as the different data sources from which data was obtained. Briefly, we explain the research paradigm adopted for the current study.

#### **3.1 Research Design for the Study**

Not so much is known in the context of the Mining Industry with respect to importance of circularity in waste management in Zimbabwe. As a result, this study applies Systematic Review of Literature. This is a qualitative research methodology which involves identifying and appraising relevant literature so as to be able to answer a specific research question (Dewey and Drahota, 2016). The critical appraisal of literature in different contexts help to situate the current study. As a result, several aspects were therefore considered as outlined below;

##### **3.1.1 Samples units used in the study**

The sampling units in the study consisted of cases for circularity with respect to mining sector from the following regions; (1) European Union- early works on circularity is largely attributable to regions such as Europe. Examples from countries were used (2) African countries- Countries which have embraced circularity in the continent were used as reference points and (3) Zimbabwe- as the central focus of the current study. Special reference was made to the mining architecture of Zimbabwe.

##### **3.1.2 Literature used in the study**

The literature included in the study was that which focused on several aspects with respect to circularity. Apart from literature which helped in the development of the methodology for the study, key variables as well as the context of the study, other literature was also systematically reviewed. This includes that which covered importance (significance) of circularity to an economy and specifically with respect to the mining sector with focus on waste management. In addition, literature which focused on barriers as well as challenges to circularity was examined. Lastly, literature which examines policies for scaling up circularity met the inclusion criteria as well. For the study, the period covered stretches from 2008 to 2024. This period is chosen because circularity is still a novel concept. Much formal work in academia started in

the years 2000s and is ongoing. The table below summarises the literature systematically reviewed according to the guidelines just outlined

**Table 2: Summary of literature systematically reviewed**

| <b>Authors</b>                                                                                                    | <b>Contribution</b>                                                                                          |
|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Africa Circular Economic Alliance (2025).                                                                         | Circular economy contextual analysis within Africa                                                           |
| Aggreko (2018)                                                                                                    | Challenges facing mining industry                                                                            |
| Jose, S.A, S., Calhoun, J., Renteria, O. B., Mercado, P., Nakajima, S., Hope, C. N., ... & Menezes, P. L. (2024). | Policies for promotion of circularity in the mining industry                                                 |
| Baranski, A (2021).                                                                                               | Theoretical framework                                                                                        |
| Dewey, A. & Drahota, A. (2016)                                                                                    | Methodology-systematic review                                                                                |
| Ekins, P., Domenech Aparisi, T., Drummond, P., Bleischwitz, R., Hughes, N., & Lotti, L. (2020).                   | Background on circularity concept                                                                            |
| European Parliament News (2023).                                                                                  | Background on circularity<br>Significance of circularity<br>Case studies on circularity best practices       |
| Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017).                                            | Significance of circular economy                                                                             |
| Godfrey, L. (2021).                                                                                               | Significance of circular economy                                                                             |
| Govindan, K., & Hasaganic, M. (2018).                                                                             | Barriers to circular economy<br>Drivers of circularity<br>Case studies on best practices on circular economy |
| Kinnunen, P., Karhu, M., Yli-Rantala, E., Kivikytö-Reponen, P., & Mäkinen, J. (2022).                             | Policies for promoting circularity in mining sector                                                          |

|                                                                                         |                                                                                         |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Kirchherr, J., Reike, D., & Hekkert, M. (2017).                                         | Background on circularity<br>Conceptual framework                                       |
| MacArthur, E. (2013).                                                                   | Background                                                                              |
| Manyuchi, M. M., Mupoperi, N., Mbohwa, C., & Muzenda, E. (2019).                        | Policies on circularity on waste management                                             |
| Mining and Minerals Act 21:05, Government of Zimbabwe.                                  | Mining context of Zimbabwe<br>Audit of current mining framework of Zimbabwe             |
| Pittway, L. (2008)                                                                      | Methodology                                                                             |
| PwC (2021).                                                                             | Significance of circularity                                                             |
| Scarpellini, S., Portillo-Tarragona, P., Aranda-Usón, A., & Llena-Macarulla, F. (2019). | Case study of circularity in practice                                                   |
| Thalang, C (2022).                                                                      | Background of circularity                                                               |
| Tavingeyi, T (2017)                                                                     | Case study                                                                              |
| The Chronicle (2023, January 23).                                                       | Case study                                                                              |
| The Herald (2023, June 1).                                                              | Zimbabwean mining context                                                               |
| The Zimbabwean Mail (2023, May,15).                                                     | Zimbabwean mining context                                                               |
| Upadhyay, A., Laing, T., Kumar, V., & Dora, M. (2021)                                   | Barriers to circularity in mining industry<br>Drivers of circularity in mining industry |
| Victor, A. (2023).                                                                      | Methodology                                                                             |

### **3.2 Data Sources**

There are different types of data sources which can be used in research. Broadly they are categorized into primary and secondary data sources. Primary data sources refer to data sources in which a researcher obtains data from field work and does not rely on already existing data sets (Victor, 2023). Further, the author highlights the following tools for collecting primary data. They include Observation, experiments, interviews, questionnaires, and surveys. For the efficacy of the study, the following were the secondary data sources used. These include circular economy reports, journals, bulletins, magazines, books and online repositories from sites of organisations such as World Bank, Zimbabwe Statistics (ZIMSTAT), policy papers from key institutions such as Africa Development Bank and online information from institutions such as ICMM-Mining and Metals Industry Global Board; Data Bridge Market Research, Fraser Institute Annual of Survey of Mining Companies Reports.

These were chosen because secondary data is readily available, less time-consuming and there are no financial constraints in terms of accessing it. However, for other institutions and organisations, data may be available for a fee.

There are, however, shortcomings that are encountered when handling secondary data; not all data can be relevant in answering the objectives of the study and a researcher may have to filter till they get the most appropriate data. Further, there is a risk of using data which can contain mistakes. This may in turn give misleading conclusions.

### **3.3 Data Collection and Variables**

#### **3.3.1 Data Collection**

The study uses secondary data to answer the research objectives. Data was collected primarily online from repositories of agencies focused on mining, published literature, government policy documents from Ministry of Mines (Zimbabwe) and also relevant conference proceedings.

#### **3.3.2 Variables for the study**

To make sure that the objectives of the study are attained, the following variables will be studied. The specific importance of each variable is outlined below;

#### **3.3.3.1 Government**

Government is key in any economy. This is because of various interventions it institutes. These affect several industries across an economy. With respect to circularity the government can have a say. This promotes or stifles circularity.

#### **3.3.3.2 Private sector**

For any economy, private sector is crucial. Most importantly, private sector responds to incentives which are availed in the economy by the government. This will help to grow or curtail circularity.

#### **3.3.3.3 Academia**

Where institutions of higher learning are situated in circularity form any economy is very important. They lead in innovation, developing relevant products, technologies etc. This happens if they are availed with requisite resources. It also depends on the government's support.

#### **3.3.3.4 Infrastructure**

The role of infrastructure in circularity is important. Lack of appropriate infrastructure can curtail circularity with respect to mining sector.

#### **3.3.3.5 Technology**

Full circularity will also depend on the state of technology in an economy. This presents opportunities as well as challenges as shall be explored in the study.

#### **3.3.3.6 Role of economic clusters**

Understanding the special role economic clusters can play in enabling circularity is important. They should be part and parcel of circularity activities.

#### **3.3.3.7 Sustainable industries**

At the heart of success circularity is issue of sustainability. It will be important to also see the specific type of industries as well as the role they can play within the circularity framework.

### **3.4 Data Analysis**

All the data gathered from the systematic review of literature will be analysed thematically. Thematic Analysis helps us to partial out themes which were identified in the data obtained from literature. This will be in line with the study objectives as well as the various themes which would answer our research objectives were identified. The themes extracted from

literature reviewed were recurring and meaningful data as well as patterns. These were ranked and then discussed. To this end, thematic analysis will be used to analyse the information obtained in the study from the case studies, documents as well as literature. The various themes which are relevant to the study include the following; significance of mining to Zimbabwe's economy; opportunities for implementing circularity in waste management for mining sector in Zimbabwe; challenges of implementing circularity in waste management for mining sector in Zimbabwe; barriers in implementation of circularity in waste management for mining sector; drivers of circularity in waste management for mining sector and strategies to enhance circularity in mining sector for Zimbabwe.

### **3.5 Limitations of the study**

The following are the major limitations of the current study;

#### **3.5.1 Data availability**

The subject of circularity with respect to the mining sector remains nascent for many developing countries including Zimbabwe. As a result, there is dearth of relevant information for policy and academic discourses.

#### **3.5.2 Time and Financial Resources availability**

Time was inadequate to cover the study fully. In addition, most of the processes were financed from personal resources which were not adequate.

#### **3.5.3 Generalizability**

Any study results need to be generalisable in order for them to be replicable as well as applicable to a wider population (sample). Our current study relates circularity to the mining and waste management in Zimbabwe. It will also be important if specific company data can be available, it will add rigour to the study. In addition, this will make the study findings representative.

## **CHAPTER 4**

### **PRESENTATION OF RESULTS**

#### **4.0 Introduction**

The chapter presents results in terms of the various thematic areas identified in the methodology section in Chapter 3. Following the systematic review of literature and the thematic analysis of the emerging themes, the following were identified; Significance of mining to Zimbabwe's economy, opportunities for implementing circularity in waste management for mining sector in Zimbabwe, challenges of implementing circularity in waste management for mining sector in Zimbabwe, barriers in implementation of circularity in waste management for mining sector, drivers of circularity in waste management for mining sector and strategies to enhance circularity in mining sector for Zimbabwe. The approach was to look at the themes from the broader perspective and narrow them to the mining sector of Zimbabwe.

#### **4.1 Significance of mining to Zimbabwe's economy**

Mining is an important industry globally as well as Zimbabwe. ZIDA (2025) shows that Zimbabwe is among Africa's top ten mineral producers. At the same time, the country is a force to reckon with for selected minerals globally. For example, ZIDA (2025) shows that Zimbabwe contributed 7.3 % of global platinum output. Besides this, mining contributes 80 % to exports in Zimbabwe, 13 % to Gross Domestic Product as well as 70 % to Foreign Direct Investment (FDI) (ZIDA, 2025).

Mining is an anchor of the Zimbabwean economy. National Trade Development and Promotion Organisation of Zimbabwe ([NTDPOZ],2025) shows that the country has over 40 minerals. Most of them are concentrated in the Great Dyke which is a geological body of over 550 kilometres. Further, the Chamber of Mines of Zimbabwe Annual Report (2022) also shows that the country that has over 800 active mines.

So, through circular economy and closing loops as well as increasing efficiency mining can be deepened. Thus, there is more scope for revenues, more jobs by taking advantage of waste management practices.

Circularity is also relevant to the economy of Zimbabwe in that it is another way which helps to promote environmental sustainability practices. In Zimbabwe currently there is a lot of destruction of the environment due to disregard of the need to preserve the environment. This is also affecting other countries in the regional economy. For example, proliferation of Chinese linked entities as they prospect for minerals in Zimbabwe has resulted in environmental

carnage. In Zimbabwe recently, a Chinese linked entity discharged over 50 million of acid in Kafue River resulting in its contamination (Mining.com, 2025).

## **4.2 Drivers of circularity in waste management for mining sector.**

Research shows that there are numerous drivers to circularity in waste management for the mining sector. These are explained in detail below;

### **4.2.1 Role of government in promotion of circularity**

Government efforts are instrumental in driving circularity in waste management in the mining sector. This is relatable to Zimbabwe as well in a number of ways. Government has power to put in place requisite legislation for companies in areas to promote circularity in waste management. Recent literature such as Jose et al., (2024) shows that through a number of strategies including, valorisation, water reuse, resource recovery, resource recovery from mining tailings-circularity can be enhanced. Government can thus play a lead role through enforcing as well as encouraging mining concerns to adapt these.

In Zimbabwe, mining is regulated through the Mining and Minerals Act Chapter 21:05. Besides, a lot of other stakeholders are part of the mining ecosystem in Zimbabwe. Provisions of the act allows for other relevant statutes such as those with respect to labour, environment, forex exchange and others. Labour laws for instance help to make sure that laws of the land with respect to recruitment and compensation of labour are fair.

Attempts at ensuring that circularity is followed in the mining sector are evident through the mining sector. For instance, the Mining Sector has provided a ban for export of raw base minerals. This seeks to improve beneficiation. The Environmental Management Authority (EMA) has several provisions promoting circularity. These touch on areas such as waste disposal as well as effluent disposal. Specifically, there are licenses with respect to waste disposal and effluent disposal from mining activities.

The current weakness in the Mining Act is that there is paucity of knowledge on how circularity can be embraced as part of the broader mining sector development. Circularity goes beyond waste and effluent management. The current act is largely inclined on waste management. However, in all the 27 parts of the Act, all this is mute. Thus, circularity is still regarded as a peripheral issue.

### **4.2.2 Infrastructure**

For circularity, infrastructure is key. This helps in enabling circularity in waste management within the mining sector. Aspects such as availability of road/ rail systems, water and power supply help to drive this industry. For instance, power supply is one key element which is

important for the mining sector operations. The Chamber of Mines of Zimbabwe shows that mining consumes 16 % of total electricity demand in the country. In addition, power demand is expected to double. This is on condition of realizing the USD 12 billion mining vision. Adequate and reliable power supply is important for various operations of mining. In addition, the cost of power is also key.

The experience of Zimbabwe with respect to power supply as an example has resulted in many entities struggling across industries. It is even debilitating for the mining industry given its reliance on power. In addition to power cuts, tariffs in Zimbabwe have resulted in high cost of doing business when compared to other countries in the region. The following table gives a comparative schedule of power tariffs in the SADC region.

**Table: 3 Comparative tariff schedule SADC region**

| Country  | Regulator | Utility                 | Tariff Cost/Unit (USD) |
|----------|-----------|-------------------------|------------------------|
| Zimbabwe | ZERA      | ZESA                    | 8.095                  |
| Lesotho  | LEWA      | LEC                     | 7.769                  |
| Zambia   | ERB       | ZESCO/ CEC/ NDOLA/ LHPC | 7.000                  |
| Angola   | IRSEA     | ENDE                    | 2.952                  |

**Source: Malawi Energy Regulatory Authority (2023)**

From the above table, it can be seen that entities operating in Zimbabwe face steeper tariffs compared to others in neighbouring countries.

#### **4.2.3 Private Sector participation in circularity**

It is key for the private sector to be involved in circularity. There is a caveat here. Private sector can only participate if an enabling environment exists. The government should take a leading role in ensuring that private capital flourishes. This is through several ways such as enabling laws and regulations, infrastructure, incentives as well as ensuring that fairness exists across the board.

On the other hand, unfriendly policies escalate cost of doing business eventually shutting out business. Zimbabwe has often struggled to keep a clean and conducive environment. Often government has sent mixed policy signals which have made it difficult for mining concerns to

commit long term investments. For example, Indigenization Laws by government have been subject to misinterpretations, scarring investors in the process.

Besides this, Zimbabwe has been in persistent currency crisis since the famous Black Friday back in 14 November 1997 when the Zimbabwean dollar crashed. This has caused exchange rate complications for companies in terms of repatriation of profits and importation of key spares for their operations. A study by Steenbergen et al., (2025) shows exchange rate distortions alongside inflation have resulted in Zimbabwe losing over three billion US dollars between 2020 and 2023. All this causes uncertainty in terms of planning for firms.

#### **4.3 Barriers in implementation of circularity in waste management for mining sector**

There are many barriers to implementation of circularity in waste management for the mining sector. Barriers are defined as impediments which make it impossible for circularity to be implemented fully. These barriers include; nascent nature of circularity for most economies,

##### **4.3.1 Nascent nature of circular economy**

Circular economy is still new and an emerging concept Upadhyay et al., (2021). Full circularity as explored earlier on goes beyond the notion of recycling which it is often associated with. Presently, embracing the concept for regions such as Africa where Zimbabwe belongs is still novel. Literature shows that regions such as Asia and Europe, circular economy implementation is quite advanced. For instance, Godfrey (2021) shows that emerging markets like Brazil, Russia, India, China and South Africa (BRICS) have advanced circularity for sectors such as mining.

Coming to Africa, a survey by African Circular Economy Alliance Baseline Survey (2022) shows that circularity is active in a few countries in Africa. These include Algeria, Nigeria, Tunisia, Egypt, Kenya, Rwanda and Madagascar. For these countries also, they have implemented National Circular Economic Policies.

For Zimbabwe, with respect to circularity in general it is still an emerging concept. In addition, there is a lack of awareness on the centrality it can play on the greater national economy. Presently, the Mining Act does not explicitly provide circularity in the mining sector. Additionally, agencies such as Environmental Management Agency does not cover comprehensively circularity in its framework. All this impedes full circularity.

##### **4.3.2 Technical constraints**

Full circularity of waste management in the mining sector requires appropriate technology. This covers a lot of areas such as waste disposal, recycling, re-use and others. Obtaining the

requisite comes at a cost. Linear economy-oriented models result in more profit to firms as there is no closing of loop in relation to mining activities.

Manutan (2025) highlights that there is limitation in terms of real data required also. This limits knowledge on crucial information emissions, material use, efficiency, etc. These are critical in implementation of circular economy in mining sector.

Coming to Zimbabwe, is the state of technology in the mining sector adequate to be able to cause and sustain circularity? Chilunjika (2024) highlights that the fourth industrial revolution has brought endless possibilities for technology in mining sector such as automation, e waste management, all which aim to enhance efficiency. However, presently, adoption of appropriate technologies within the mining sector remains heavily constrained. Chamber of Mines Annual Report, (2023) shows that mining concerns in the country are still relying on obsolete technologies.

#### **4.3.3 Weak legislation and enforcement**

Full circularity in the mining sector through waste management implies that entities salvage value from every level of their activities. However, weak legislation and enforcement can actually act as a barrier for successful implementation of circularity with respect to waste management. In Zimbabwe for example, EMA imposes a fine of USD 5000 for firms found to be polluting the environment. This is considered level 4 and considered severe.

The experience with Zimbabwe at the present however has seen powerful entities deliberately polluting and later pay fines. For example, Bikita Minerals situated in Masvingo Province is a well-known lithium producer. In the year 2024, the company discharged effluent into Matezva Dam, a local water reservoir (Zimtracker, 2024). The dam plays a crucial role for agricultural activities for local communities. Despite being levied with an initial fine of USD 5000, the company went on to discharge more effluent as well. This irresponsible behaviour by mining concerns is actually perpetuated by lax legislation in place.

#### **4.4 Opportunities for implementing circularity in waste management for mining sector**

There are a number of opportunities which can be harnessed to fully exploit circularity in the waste management sector of mining in Zimbabwe.

##### **4.4.1 Recycling and reusing in the mining sector**

Through recycling and reuse, product life cycles are extended. Besides, this also helps to reduce environmental footprint. In the process this helps to close the loop which is a concept at the heart of circular economy. Jose et al., (2024) further show that due to recycling of mining by products, industry hubs can sprout. This goes a long way in creation of additional employment

and other associated benefits. In 2015, Mimosa Platinum Mines of Zimbabwe announced plans to recycle over 20 million tons of its mine dumps. The company announced that this will enable it to be able to recover platinum. For this to be successful however, the company reiterated the need for appropriate technology (The Chronicle, 2015).

#### **4.4.2 Digitalisation of mining technologies**

The role of technologies is critical (Kinnunen et al.,2022). In the waste management of the mining sector, the authors argue that application of different technologies acts as an opportunity to help support material management and waste to resource matching. This means that, technologies actually enhance valorization of mining waste. For many Zimbabwean firms, in the mining sector, technology being relied upon is mainly antiquated (Chamber of Mines, 2023). This implies less value addition and beneficiation. This results in inefficient and often wasteful practices with respect to mining. Digitalisation of technologies for the sector implies using advances such as Artificial Intelligence (AI), automation, robotics to aid not only extraction but processing as well.

#### **4.4.3 Scrap metal**

An industry such as scrap metal presents immense opportunities for Zimbabwe. This is an important niche which the country can exploit for enhancing waste management in terms of scrap metal. At the moment, not much exists in the country to unlock value in this industry. Zimbabwe Institute of Foundries (ZIF) highlights that presently Zimbabwe loses over 5000 tonnes of scrap metal yearly due to smuggling. This translates to approximately USD 1.5 million in monetary value (The Zimbabwean Mail, 2023). In addition, ZIF points out that value addition of scrap metal has potential to earn the country income of over USD 5 million per year. Currently, from the policy side, government has been lacking.

## **Conclusion**

In conclusion, the chapter presented the results developed from the systematic review of literature. Through use of thematic analysis, several thematic areas were identified. The chapter proceeded by identifying each theme and discussing it. The chapter located circularity of waste management of the mining sector in Zimbabwe. These include significance of mining to Zimbabwe, barriers, challenges and opportunities for circularity in waste management. Mining sector contributes to export earnings and employment in Zimbabwe as presented in the chapter. Factors such as infrastructure, technology constraints as well as weak legislation act as barriers to circularity. For instance, weak legislation in the context of Zimbabwe as we highlighted in the main write up results in efforts at waste management being derailed. On the other hand, absence of appropriate technology makes it difficult for implementation of circularity. Lastly, there are opportunities for circularity in waste management in mining in Zimbabwe as literature has shown. These include leveraging on recycling and emergence of technologies.

## **CHAPTER 5**

### **DISCUSSION OF FINDINGS**

#### **5.0 Introduction**

This chapter discusses the various themes presented in the findings, Chapter 4. The discussions of the findings are centered on the following: (1) How the study is similar to previous studies (2) How our study differs from previous studies as well as (3) Any peculiarities of the current study. The discussions will be centered on the thematic areas developed in Chapter 4 after a systematic review of literature.

#### **5.1 Discussion of Major Themes in the Study**

##### **5.1.1 Significance of mining to the Zimbabwean economy**

The mining sector is a key industry globally as shown in Figure 6 (Appendix section). This study has shown that mining is central to the economy of Zimbabwe through its contribution to various thematic areas including GDP contribution, revenue generation, employment as well as linkages in the broader economy. As a result of this, there is massive potential for it to be designed with circularity of waste management through the broader economy. This finding is congruent to studies such as Godfrey (2021) and Aggreko (2018). The only difference of these studies with the current study is that the latter relate to contexts where circularity has been applied at advanced level and has been part of policy making at national level.

##### **5.1.2 Opportunities for implementing circularity in waste management for mining sector**

In the findings, it has been shown that there are many opportunities in waste management for the mining sector. These include wastewater recycling as well as scrap industry targeting industries such as steel manufacturing. Literature such as Jose et al., (2024) underscores the importance of this as it can stimulate development of other industries. In Zimbabwe, current literature has shown that mining concerns such as Mimosa, Bikita Minerals have plans underway to implement waste management in their mining operations. (The Chronicle, 2015; Zimtracker, 2025).

This study corroborates with other works such as Vercammen et al., (2017). The authors show scrap metal industry in China has a lot of potential. However, at the moment its full potential has not been realised. This is mainly because government is still struggling to come up with policies to maximise the potential.

Similarly, Oyedele et al., (2018) underscore the important role scrap metal plays for the economy of Nigeria. Apart from income and jobs generated, the industry offers important synergies with other industries. The study is similar to the current study in that the authors further highlight that government has not done much with respect to policies to and enabling laws to stimulate this industry.

### **5.1.3 Digitalisation of mining technologies**

For efficacy of waste management literature emphasises on the important role technology can play (Kinnunen et al., 2022). These may include technologies such as Artificial Intelligence which in turn will enable the waste management of the mining sector. The authors argue that application of different technologies acts as an opportunity to help support material management and waste to resource matching. This means that, technologies actually enhance valorization of mining waste. For many Zimbabwean firms, in the mining sector, technology being relied upon is mainly antiquated (Chamber of Mines, 2023). This implies less value addition and beneficiation. This results in inefficient and often wasteful practices with respect to mining. Digitalisation of technologies for the sector implies using advances such as Artificial Intelligence (AI), automation, robotics to aid not only extraction but processing as well.

### **5.1.2 Drivers of circularity in waste management for mining sector**

With respect to Zimbabwe, the study has shown that there are current gaps including weak legislative infrastructure as revealed in the Mining Act, lax labour laws, lack of enforcement by responsible agencies like Environmental Management Agency (EMA). For example, the mining sector through the Chamber of Mines is facing serious infrastructure challenges such as lack of electricity. All these curtail implementation of circularity in waste management for the mining sector as well as attaining the USD 12 billion industry. Besides this, the current legislative instrument is no longer in tandem with current dynamics in the mining industry. A lot of value cannot be unlocked under the outdated act.

However, the study has revealed the importance of several factors for driving circularity in waste management for the mining sector. These include infrastructure, role of government as well as private sector participation and academia through collaboration. These variables help in ensuring that circularity in waste management is enabled. For example, these factors allow for valorization, resource recovery as well as closing the loop in mine tailings as shown in studies such as Jose et al., (2024).

### **5.1.3 Barriers in implementation of circularity in waste management for mining sector**

The findings revealed that there are many barriers which can work against implementation of circularity with respect to any sector in general. These include technological, knowledge and skills, weak circularity framework among others. With respect to Zimbabwe, not much has been done in the mining sector with special focus on circularity of waste management. Gaps do exist. The main gap emanates from the policy level. Government through the parent ministry still has a lot of work to do with respect to stimulating circularity via waste management.

## **CHAPTER 6**

### **CONCLUSION AND RECOMMENDATIONS**

#### **6.0 Summary**

The broad aim of the current study was to study explore the benefits of adopting circular economy in waste management with respect to the mining sector of Zimbabwe underpinned with three objectives. The study was relevant at a time when the Government of Zimbabwe has set an ambitious target of transforming the mining industry into a USD 12 billion industry. In this study, circular waste management in the mining industry is seen as one way to also help towards this target. A systematic review of literature helped to partial out four themes which helped to build a conceptual framework guiding the study. Challenges as well as opportunities in relation to the industry studied were identified. This chapter presents in detail policy implications of the study as well as the policy recommendations and conclusion.

#### **6.1 Conclusion**

The study gave an in-depth analysis of the theme of circular economy and what it means when applied to mining sector. Focus was on the Zimbabwean economy. Presently, as shown in the study the government has an ambitious target of scaling mining to be a USD 12 billion industry. This is a noble target given that mining contributes significantly to the GDP of the economy. The study presented a compelling case on the need to unlock value towards attainment of this target. Circularity with special focus on waste management is one such niche which is currently underutilized. This can help towards attainment of the target. However, the study articulated the hurdles which are currently in place so as to achieve circularity. These include, weak role of government, poor infrastructure, weak synergies and collaborations, high cost of critical enablers such as power among others.

Delving deeper into discussions, the study showed potential of the sector if several strategies are implemented. These include raising awareness, active participation by government, collaboration of stakeholders as some of the policies which can drive circularity of waste management. There is a lot of potential in the mining sector of Zimbabwe if circularity is implemented with respect to waste management. This helps to expand the scope of this industry. In the process the value embedded in this sector can be unlocked. Accordingly, mining will contribute a lot in terms of GDP, employment, income, sustainability as well as competitiveness of the sector amongst peers in the region.

## **6.2 Recommendations**

From the detailed policy implications presented from the previous chapter, there are a number of recommendations which can be considered. As seen in the study, the mining industry is key for Zimbabwe. As a result, there is need for expeditions implementation of outstanding areas. These include aspects such as the legislation governing the Mining industry. It should be tailored to speak to current dynamics of the industry.

For the full circularity to be implemented, all critical enablers should be well aligned. For instance, current infrastructure gaps in the Zimbabwean economy should be dealt with. From literature, infrastructure can stand in the way of properly reaching full potential of the sector.

Related to the above, there is also need to create a conducive business environment across the economy. A good business environment is a boon for the mining sector. This helps to attract various investments in industries such as mining. There can be potential investors in circularity within the sector. However, they need assurance as to whether their investments are safe and secure.

The study also recommends future studies to explore specific entry points for circularity in the waste management sector. For example, it will worthwhile to study the impact scrap industry can have to the Zimbabwean economy. Scrap is an essential waste of the mining sector. However, it has not been fully valorized. Specifically, the study recommends the following;

### **6.2.1 Role of government**

The starting point in implementation of circularity should be through active participation by government. The Zimbabwean mining sector has USD 12 billion as a goal for this particular industry. As a result, the government plays a critical role in stimulating this goal. From the findings, regions such as Europe have advanced in circularity. This has largely been as a result of government taking a lead role. The following is what the government can do;

- Enacting laws to enable circularity-e.g. improvement of the current Mining Act so that it speaks to recent developments as well as gaps in the sector.
- Creation of a platform of bringing together all stakeholders involved in circularity.
- Creation of incentives for players in the mining sector
- Establishment of policies to stimulate mining sector expansion leveraging on circularity
- Infrastructure to promote circularity of waste management
- Law enforcement so as to clamp down on smuggling for instance of scrap metal.

### **6.2.2 Awareness on the value of circularity in waste management for the mining sector**

In the study, findings showed that there is immense potential in implementing circularity form the mining sector in Zimbabwe. There is however a need to scale up awareness on the significance of the important role this can play for the industry. One strategy of scaling up is for Zimbabwe to learn from other countries which have succeeded in this respect.

### **6.2.3 Collaboration of different stakeholders in the circularity ecosystem**

Full efficacy of circularity requires a broad-based approach which brings different stakeholders in the circularity ecosystem. Specifically, the coming together of academia, government as well as private sector is key in ensuring development of strategies informed by different stakeholders. This helps in generation of requisite policies and incentives for boosting circularity initiatives in the mining sector.

### **6.2.4 Role of technology**

The findings have shown that technology plays a big role in enabling circularity of waste management in the mining sector. It is therefore imperative to ensure that actors in this value chain invest in up-to-date technologies. This goes a long way in valorising the mining sector of Zimbabwe. The government can play a leading role through provision of incentives towards development of local initiatives in creation as well as adoption of new knowledge in line with contemporary trends in the mining sector.

### **6.2.5 Capacity building of lobby groups**

In Zimbabwe, the Chamber of Mines is one of lobby groups which is instrumental in ensuring that government is aware of the needs of this constituent. However, a lot can be done by this and related bodies so as to ensure that their demands are met.

### **6.2.6 Cost doing business**

Success of the mining industry in general will hinge on how this sector is able to manage different cost drivers it faces. In the study we showed how Zimbabwe compares with regional peers on costs such as electricity. Comparatively, Zimbabwe remains a high-cost destination. Mining industry is a giant consumer of electricity and it is a significant cost driver for mining concerns. So, this state of affairs only results in the country failing to attract investors.

### **6.3 Entry points for circularity in waste management in the mining sector for Zimbabwe**

Circularity entails a lot in terms of reusing, recycling, regeneration of value. So, the question is which should be the entry point for circularity in Zimbabwe? Circularity is still nascent in Zimbabwe. As such initiatives such as recovering, reclaiming and regeneration will be key to driving circularity of this sector. The findings have shown efforts being made by industry giants such as Mimosa, Bikita Minerals in these initiatives. This will give a good entry point for circularity in waste management for the mining industry.

## References

- Africa Circular Economic Alliance (2025). Charting Africa's path to circularity. Retrieved, 10 October 2024 from: <https://www.aceafrica.org>
- Aggreko (2018). Five Common challenges facing the mining industry. Retrieved, 10 October 2024 from, <https://www.aggreko.com/en-pg/news/2018/auspac-news/10-oct/five-common-challenges-facing-the-mining-industry>
- Baranski, A (2021). Linear Economy: Characteristics and Criticism. Available at: <https://www.profolus.com/topics/linear-economy-characteristics-and-criticism/>
- Chilunjika, A (2024). Application of fourth industrial technologies: a case of Zimbabwe's mines, *Insights into Regional Development* 6(4): 124-140. <https://doi.org/10.70132/a2354787553>
- Dewey, A. & Drahota, A. (2016) Introduction to systematic reviews: online learning module *Cochrane Training* <https://training.cochrane.org/interactivelearning/module1-introduction-conducting-systematic-reviews>
- Ekens, P., Domenech Aparisi, T., Drummond, P., Bleischwitz, R., Hughes, N., & Lotti, L. (2020). The circular economy: What, why, how and where. UCL Institute for Sustainable Resources, University College London
- European Parliament News (2023). Circular economy: definition, importance and benefits. Retrieved, 12 November 2024 from : <https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits>
- Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy—A new sustainability paradigm? *Journal of cleaner production*, 143, 757-768.
- Godfrey, L. (2021). The circular economy as development opportunity. CSIR: Pretoria
- Govindan, K., & Hasaganic, M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. *International Journal of Production Research*, 56(1-2), 278-311.
- Halog, A., & Anieke, S. (2021). A review of circular economy studies in developed countries and its potential adoption in developing countries. *Circular Economy and Sustainability*, 1(1), 209-230.
- Jose, S. A., Calhoun, J., Renteria, O. B., Mercado, P., Nakajima, S., Hope, C. N., ... & Menezes, P. L. (2024). Promoting a Circular Economy in Mining Practices. *Sustainability*, 16(24), 1-34.
- Kinnunen, P., Karhu, M., Yli-Rantala, E., Kivikytö-Reponen, P., & Mäkinen, J. (2022). A review of circular economy strategies for mine tailings. *Cleaner Engineering and Technology*, 8, 100499.

- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, conservation and recycling*, 127, 221-232.
- MacArthur, E. (2013). Towards the circular economy. *Journal of Industrial Ecology*, 2(1), 23-44.
- Mahonye, N., & Mandishara, L. (2015). Mechanism between mining sector and economic growth in Zimbabwe, is it a resource curse?. *Environmental economics*, (6, Iss. 3), 81-92.
- Malawi Energy Regulatory Authority (2023). Comparative Energy Prices Within the Sadc Region as at 23 November 2023
- Manutan (2025). What are the circular economy business models? <https://www.manutan.com/blog/en/circular-economy/how-to-start-a-circular-economy-in-your-business-strategy-and-how-to-implement-it>
- Manyuchi, M. M., Mupoperi, N., Mbohwa, C., & Muzenda, E. (2019). Treatment of wastewater using vermifiltration technology. *Water conservation, recycling and reuse: issues and challenges*, 215-230.
- Mining.Com (2025). Acid spill from Chinese-owned copper mine contaminates vital waterway in Zambia. <https://www.mining.com/acid-spill-from-chinese-owned-copper-mine-contaminates-vital-waterway-in-zambia/>
- Mining and Minerals Act 21:05, Government of Zimbabwe. Retrieved, 24 March 2025 from: <https://www.jsc.org.zw/upload/Acts/1961/2105updated.pdf>
- Oyedele, A. F., Brimah, N., & Abu, Z. (2018). Scrap Metal Business: A Viable Channel of Income Generation in Kwara State. *Journal of Education in Developing Areas*, 26(2), 577-586.
- Pittway, L. (2008) Systematic literature reviews. In Thorpe, R. & Holt, R. The SAGE dictionary of qualitative management research. SAGE Publications Ltd doi:10.4135/9780857020109
- PwC (2021). The rise of circularity. Retrieved, 10 October 2024 from: <http://www.pwc.com/m1/en/publications/the-rise-of-circularity/documents/the-rise-of-circularity-metals-mining.pdf>
- Scarpellini, S., Portillo-Tarragona, P., Aranda-Usón, A., & Llena-Macarulla, F. (2019). Definition and measurement of the circular economy's regional impact. *Journal of Environmental Planning and Management*, 62(13), 2211-2237.
- Steenbergen, V., Pindiriri, C., Psillos, J., & Kwaramba, M. (2025). The fiscal costs of monetary and exchange rate policy distortions in Zimbabwe.
- Thalang, C (2022). Circular Economy Principles. Retrieved, 12 November 2024 from: <https://www.alamy.com/7r-circular-economy-principles-concept-for-economic->

[sustainability-of-production-and-consumption-has-7-steps-to-analyze-such-as-reduce-recycle-recov-image488077680.html](https://www.mindat.org/photo-840994.html)

Tavingeyi, T (2017). Asbestos mine dumps. Retrieved, 22 March 2025 from: <https://www.mindat.org/photo-840994.html>

The Chamber of Mines (2022). Annual Report. <https://chaminess.co.zw/assets/uploads/2023/application/3bb36313-f1fc-470d-81fe-dd628d9a2694.pdf>

The Chronicle (2023, January 23). Mimosa Mine to Recycle Dumps. <https://www.chronicle.co.zw/mimosa-mine-to-recycle-dumps/>

The Herald (2023, June 1). USD 12 Mining Industry on Course. <https://www.herald.co.zw/us12-billion-mining-economy-on-course/>

The Zimbabwean Mail (2023, May,15). Zimbabwe Loses US\$1.5m/yr. to Scrap Metal Smuggling. [Zimbabwe Loses US\\$1.5m/yr. to Scrap Metal Smuggling – The Zimbabwe Mail](https://www.zimbabwean.co.zw/news/zimbabwe-loses-us1.5m-yr-to-scrap-metal-smuggling-the-zimbabwe-mail)

Upadhyay, A., Laing, T., Kumar, V., & Dora, M. (2021). Exploring barriers and drivers to the implementation of circular economy practices in the mining industry. *Resources Policy*, 72, 102037.

Vercammen, S., Chalabyan, A., Ramsbottom, O., Ma, J., & Tsai, C. (2017). The growing importance of steel scrap in China. *McKinsey Company*.

Victor, A. (2023). A Review on Primary Sources of Data and Secondary Sources of Data.

Zimbabwe Investment and Development Agency (2025). Why Zimbabwe's Mining Sector? <https://zidainvest.com/key-sectors/mining-sector/#:~:text=Zimbabwe%20is%20among%20the%20top,and%2013.5%25%20to%20national%20Income.>

Zimtracker (2024). Bikita Minerals at it again, dumps waste in Matezva Dam. <https://zimtracker.org/2024/05/23/bikita-minerals-at-it-again-dumps-waste-in-matezva-dam/>

## Appendix

**Figure 6: Current levels of mining's contribution to national economies**



**Source: Ericsson and Löf (2019)**