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Livelihoods and natural resource management in fast-track lithium mining in Arcturus rural community in Zimbabwe

By

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A thesis submitted to the Faculty of Science,
University of the Witwatersrand,

In fulfilment of the requirements for MSc Environmental Science degree

Supervisor: Dr Regis Musavengane

October 2025

Ethical Clearance No: GAES-2024-112

DECLARATION

I, Zanele Guvakuva, declare that this research on *Livelihoods and management of natural resource in fast-track lithium mining in Arcturus rural community in Zimbabwe* is my own work. The work has not been submitted at any other institution for any other degree. Sources used and quoted in this report have been fully referenced in acknowledgement of their use.



……... …12/10/2025……

Signature **Date**

DEDICATION

This work is solely dedicated to God. Lord, You alone know how You orchestrated everything. To You belongs all the glory.

ACKNOWLEDGEMENTS

I extend my deepest gratitude to my supervisor, Dr. Regis Musavengane, for his unwavering support, guidance, and assistance throughout this journey. Your patience and dedication are truly remarkable. Thank you, Doctor.

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To my amazing friends, support system, thank you for always being there. Your encouragement and input were invaluable, and you made the tough times easier to navigate. I owe you big time, thank you!

Above all, I give thanks to my God for His mighty hand and divine intervention in this degree as a whole. I can never say thank you enough. Lord, I am deeply grateful.

ABSTRACT

The global shift towards clean energy technology, as one of the sustainable initiatives to curb climate change, has significantly increased the demand for lithium, which is one of the key minerals in the development of this technology. This surge in demand has led to a massive expansion of lithium mining in Zimbabwe, with new mines mushrooming across the country. With the lithium boom being recent in the country, studies around this phenomenon are scarce. Previous studies and articles have primarily focused on the struggles of displaced households and small scall miners due to the lithium boom. This study introduces a livelihoods perspective focusing on communities that continue to reside adjacent to the mines. This makes it the first to apply the Sustainable Livelihoods Framework to analyse how lithium mining simultaneously affects frontline community livelihoods and water availability in Zimbabwe. Thus, offering a holistic socio-environmental perspective missing from existing research. The research investigates the livelihood changes and environmental impacts in the Arcturus rural community following the onset of the Arcadia Lithium Mine project in Zimbabwe.

A qualitative approach was followed in exploring this issue, using the Arcadia Lithium Mine project as a case study and focusing on communities surrounding the mine. Semi-structured interviews were conducted with 29 research participants, who were selected through purposive and snowball sampling methods. Grounded in the Sustainable Livelihoods Framework (SLF), livelihood changes were examined. Thematic analysis was used to interpret the data. By integrating environmental dimensions, particularly water availability into the SLF analysis, this study extends the framework's application and demonstrates its utility in capturing the intertwined socio-environmental consequences of resource extraction. The findings revealed that all five capitals of the SLF as well as the environment have been negatively affected by the mine.

To a large extent, the communities' livelihoods did not improve following the establishment of the mine in their locality. Key livelihood activities affected included the loss of farmlands, grazing areas, fishing grounds, and reduced social interactions. While the impacts were not uniform across communities, the most affected community

with all 5 capitals affected was Lawfield, where the mine claim is located. Some communities experienced greater disruption to social cohesion and natural capitals, while others reported significant declines in social cohesion and physical resources. However, some positive infrastructural developments on roads and a local school were reported. Regardless, participants across all cases expressed dissatisfaction, noting that the mine had eroded their livelihoods without offering meaningful benefits in return.

In light of these findings, it is recommended that a national lithium strategy be developed and a dedicated government department be established to monitor emerging lithium mines, ensuring a balance between economic gains and socio-ecological impacts. This study's in-depth analysis of one of the newly established lithium mines provides valuable insights into the livelihood and environmental challenges associated with the current lithium mining boom. With several other mines under exploration in Zimbabwe, the findings from this research highlight critical issues that may be present elsewhere and underscore the urgency of a coordinated national response. Further research across new lithium mining communities would deepen understanding these impacts. Thus, helping determine whether the challenges experienced by the Arcadia mine communities are widespread across new lithium mines. This ensures the development of national mitigation strategies that are robust and applicable across diverse new lithium mining projects.

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ABBREVIATIONS AND ACRONYMS

EMA	Environmental Management Agency
DIFI	Department for International Development
HC	Huayou Cobalt
IPCC	Intergovernmental Panel on Climate Change
PRZ	Prospect Resources Zimbabwe
SDG	Sustainable Development Goals
SLF	Sustainable Livelihoods Framework
UN	United Nations
UNFCC	United Nations Framework for Climate Change
ZINWA	Zimbabwe National Water Authority

CHAPTER 1: INTRODUCTION

1.1 Introduction

With the ongoing worldwide shift towards clean, low carbon energy as a sustainable development initiative targeted at curbing climate change, there has been a significant drive toward renewable energy development (Tsivadzea *et al*., 2023; Vivoda *et al*., 2024; Saleth and Varov, 2023). Wind turbines as well as solar panels have become the symbol of the current clean energy movement, driving the demand for lithium-ion batteries higher (Sterba *et al*., 2019). The intermittent nature of these clean energy sources necessitates considerable backup storage solutions the energy they generate (Vivoda *et al*., 2024). Also, Lithium-ion batteries are essential for electric vehicles, which are essential for the green economy (Saleth and Varov, 2023; Liu and Agusdinata, 2020). Consequently, the global demand for lithium mineral has increased extensively in recent years and it is predicted to continue rising (ZELA, 2023; Matanzima, 2024a).

Globally, Australia, Argentina, China, and Chile have been the chief producers of lithium, with the largest share of output coming from these nations (Dorn and Gundermann, 2022; Vivoda *et al*., 2024). In Africa, Zimbabwe, Namibia, Ghana, the Democratic Republic of Congo (DRC), and Mali have been identified as key lithium sources, with a combined potential to supply five percent of the global total (Cleote *et al*., 2023). An analysis of the impacts of extracting critical transition minerals like lithium in Southern African Development Community (SADC), has highlighted significant adverse climate and environmental effects (Sagert, 2023). Other studies found that lithium mining is associated with high water consumption and contamination risks (Liu and Agusdinata, 2020; Wilson *et al.,* 2022), which could exacerbate frequent droughts (Cleote *et al*., 2023).

Although lithium mining is not new in Zimbabwe, having begun around 1950 (ZELA, 2023), Bikita Minerals was the only lithium mine in operation until 2021 (Goodenough *et al*., 2021; Mkodzongi, 2024). Recently, there has been a surge in lithium mining interests across the country (Shen and Zhou, 2023; Matanzima, 2024a). Zimbabwe currently leads the lithium race in Southern Africa (Parker, 2024). Lithium, already the

third-largest mineral export (Pavlovic and Chivanga, 2023), is considered a potential economic saviour for the country (Shen and Zhou, 2023). Zimbabwe is aiming for $12 billion in mining revenue by 2023, with untapped lithium reserves expected to be a major contributor (Government of Zimbabwe, 2023).

To support this drive, the requirement for 51% indigenous ownership in mining projects was scrapped (Shen and Zhou, 2023), and the government established an agency, Zimbabwe Investment and Development Agency for the facilitation of swift investor registration and mining operations (Mkodzongi, 2024). These business-friendly policies and revenue targets likely explain the rapid acquisition and exploration of lithium claims in the country. However, little attention has been paid to the ecological, social, and human rights impacts of lithium mining activities on local communities (ZELA, 2023). The fast-tracking of lithium mining projects can impact the environment and the livelihoods of communities negatively in mining areas.

While lithium mining creates jobs (Dorn and Gundermann, 2022) and promotes economic development (Liu and Agusdinata, 2020), it is also associated with numerous negative impacts (Canelas and Carvalho, 2023; Matanzima, 2024b). For instance, Global Witness, (2023) reported that lithium mining degrades the environment. Similarly, Cleote *et al.*, (2023) notes that it depletes and contaminates water bodies. While, Díaz Paz *et al*., (2023) and Liu and Agusdinata, (2020) say it competes for water with communities and ecosystems. Furthermore, Matanzima, 2024c) noted displacement of households and human rights abuses form lithium mining. Tscherning and Chapman (2020) argue that current lithium extraction activities do not align with the environmental and social standards required for a truly green economy.

Increasing awareness of the impacts of lithium extraction on the environment and resistance by the indigenous has led some global vehicle manufacturers, such as Volkswagen and Mercedes-Benz, to go for lithium sourced with minimal socio-environmental impact (Kashwan and Jayaram, 2023). Additionally, the European Commission's (EC) plans to expand local lithium sourcing and accelerate electric vehicle production have met with social resistance from affected communities seeking to protect their livelihoods and the environment (Saleth and Varov, 2023).

1.2 Problem Statement

Globally, there has been increasing concern over the impacts of climate change, as evidenced by greater rainfall variability, rising temperatures, higher sea levels, and more frequent droughts and floods (Church and Crawford, 2020; Liu and Agusdinata, 2020). In an effort to combat climate change, the Paris Agreement, was ratified in 2016 (UNFCCC, 2018). In addition, Sustainable Development Goals (SDGs) were developed for instance SDG 13, which is about combating climate change and its effects and well as SDG 7 focused on provision of affordable clean energy for (United Nations, 2018). As a result of these international agreements, many stakeholders intensified their efforts toward climate change mitigation (Church and Crawford, 2020).

According to IPCC, (2023) in their sixth assessment report they indicated a need for 43% and 84% reduction of greenhouse gas emissions from 2019 levels to limit warming to 1.5oC, 2030 and 2050 respectively. Apart from these projections, countries such as Australia (Matanzima, 2024a) and the European Union (EU, 2020) have already committed to achieving net zero by 2050. Pressure to accelerate this transition is also being driven by consumer preferences and the private sector (Church and Crawford, 2020), creating a pressing requirement to address climate change (Vivoda *et al*., 2024; Saleth and Varov, 2023).

One of the crucial plans to mitigate the current change in climate has been the shift to energy sources that are low in carbon, also known as clean energy (Heffron, 2020; Liu and Agusdinata, 2020; Sovacool *et al*., 2021; Tsivadzea *et al*., 2023). This is echoed by Matanzima (2024c) who says achieving these targets requires transitioning from fossil fuels to clean energy. These low-carbon ambitions come with new demands for critical mineral resources like lithium, which is key for low-carbon technology (Heffron, 2020). As a result, need for lithium, a key component in energy storage systems and electric automobiles, both of which are part of the clean energy technology become urgent (Vivoda *et al*., 2024; Saleth and Varov, 2023).

Therefore, as the demand for clean energy technologies increases, the demand for lithium rises accordingly (Church and Crawford, 2020). Already, there is worldwide race for critical (Heffron, 2020). Kotey and Rolfe (2014) echo this sentiment, stating

that recently, the mining sector for lithium has grown swiftly due to the surge in demand for clean energy technology and electric driven vehicles. Matanzima (2024a) further attributes this trend to the fast-tracking in mineral acquisition, which, he explains, is driven by major powers competing to dominate the critical minerals supply chain.

The rise in critical minerals demand should bring economic benefits to countries that are home to these resources (Church and Crawford, 2020). The low-carbon revolution has the potential to drive significant positive changes in investment flows, infrastructure development, and direct benefits to host communities (Liu and Agusdinata, 2020; Sovacool, 2021) which can improve livelihoods. Further to this, mining can improve economic prospects in remote areas, enhance infrastructure, strengthen healthcare services, and diversify the economic base (Kotey and Rolfe, 2014). Additionally, economic growth, coupled with increased income for residents of mining towns, can stimulate local businesses and encourage their expansion (Kotey and Rolfe, 2014; Liu and Agusdinata, 2020). These can result in improved livelihoods for host communities.

However, despite these positive impacts, mining disadvantage host communities in several ways. The extraction of transition minerals raises concerns about justice, (Heffron, 2020). Matanzima (2024b) argues that the accelerated extraction of these minerals often results in communities being manipulated and pressured into accepting projects that present negative impacts on them. This fast-tracking process often disguises serious socio-ecological fairness concerns and leads to the circumventing of essential engagement, dialogue and due diligence procedures in areas where mineral deposits are found (Matanzima, 2024b).

In some cases, the extraction of minerals brings suffering to communities whose lands and water sources intersect with mineral reserves, leaving them with degraded landscapes and angry (Sovacool, 2021; Matanzima, 2024c). Additional negative impacts include the destruction of cultural landmarks and the irreversible loss of species (Sovacool, 2021). Furthermore, high levels of unemployment and demographic shifts, have been widely documented in the literature (Kotey and Rolfe, 2014). Other negative consequences highlighted by Matanzima (2024a) include employment of minors, sexual violence targeted on women, unsafety working

conditions, forced evictions, and adverse health effects resulting from the environmental impacts of lithium mining.

The lithium mining sector in Zimbabwe is fairly new, and the dynamics facing the industry remain largely unknown (RLS, 2024). It is only recently, that there has been a surge in lithium mining interests across the country (Shen and Zhou, 2023; Matanzima, 2024a). This explains the limited scholarly research on lithium extraction in Zimbabwe (Mkodzongi, 2024). Much of what is known is information that comes from newspaper reports, government policy documents, and company websites.

This lithium boom created a window of economic growth for the country's ailing economy (Shen and Zhou, 2023). The government of Zimbabwe took advantage of this opportunity and introduced business-friendly policies that have since attracted investors into lithium mining (Mkodzongi, 2024). Investors have spent over US$1 billion since 2021, in acquiring and developing lithium mines in Zimbabwe (NewZWire, 2023). Seven new lithium mines have become operational since 2022 (Shen and Zhou, 2023; Matanzima, 2024c), with several others under exploration (NewZWire, 2023). Unfortunately, Zimbabwe has been identified as a fragile and corrupt state (Church and Crawford, 2020). The presence of critical minerals in such fragile economies, coupled with rising global demand, could create potential hotspots for increased socio-environmental injustice (Church and Crawford, 2020).

Although Zimbabwe has regulatory frameworks, such as the Environment Management Act (Chapter 20:27 of 2002), for the management of environmental impacts, negative social and environmental consequences persist (ZELA, 2023). The rapid increase in lithium mining operations exposes local communities to potential harm if socio-economic impacts are not carefully considered. As mentioned earlier, lithium mining has substantial negative effects on local livelihoods as well as the environment (Díaz Paz *et al*., 2023; ZELA, 2023). Therefore, thorough consideration of ecological and social impacts of new mining projects is necessary, as the pursuit of short-term profits may exacerbate the impulse to overlook these long-term harm at the local level.

Against this background, scholarly research on the impacts of lithium mining in Zimbabwe remains limited. Recently, a few articles have been published, but they primarily focus on the displacement and resettlement of communities living near or on lithium reserves (Matanzima, 2024b). Another article on lithium boom impacts on Aljazeera written by Matiashe focused on how the banning of exporting raw lithium affected small scale miners (Matiashe, 2024). Globally, the socioecological aspects of lithium extraction have been widely studied, albeit with limited coverage (Heffron, 2020; Matanzima, 2024b). These studies have mainly examined regions where lithium mining was already dominant before the recent global boom (Salev and Varov, 2023; Matanzima, 2024b), thereby excluding Zimbabwe (Matanzima, 2024a). Since Zimbabwe's lithium boom is recent, and studies are scarce, this study fills a critical knowledge gap on how this strategic mineral affects local livelihoods.

Moreover, these studies do not capture the dynamics around the recent lithium boom (Heffron, 2020). Agusdinata *et al*., (2018) also found that scholarly research on the socio-environmental impacts of lithium mining at the community level is limited. Given Zimbabwe's emerging lithium industry, scientific research is essential to understand its effects on local livelihoods and the environment.

To date, no research has examined the effects of lithium mining on livelihoods during the current lithium rush, particularly in this specific study area. While existing research on lithium mining in Zimbabwe concentrated on the displacement of families and issues of inadequate compensation, little attention has been paid to the everyday realities of communities that continue to reside neighbouring to the new large-scale lithium mining operations. This study contributes new insights by applying the Sustainable Livelihoods Framework to examine how lithium mining affects the five capitals (natural, human, social, physical, and financial) that underpin rural livelihoods. In addition, the research integrates environmental dimensions, particularly the impact on water availability, into the analysis of livelihoods. This combined socio-environmental perspective provides a more holistic and nuanced understanding of how lithium mining shapes community well-being in Zimbabwe, thereby addressing a critical gap in the literature.

Understanding the dynamics associated with lithium mining in Zimbabwe is crucial, which is why this research was undertaken. In light of this, the study contributes to scholarly literature by analysing how lithium extraction has impacted livelihoods and the environment in one of Zimbabwe's newly developed lithium mines.

This partly filled that knowledge gap on lithium mining impacts on community livelihoods and the environment in Zimbabwe. The findings provide valuable insights for decision-makers, stakeholders, and researchers to develop effective mitigation strategies. This research also contributes to the growing body of literature on lithium mining and help policymakers make informed decisions.

1.3 Aim of the study

This study aimed to investigate the changes in livelihood experiences of the Arcturus rural community in Zimbabwe following the onset of lithium mining activities and environment, particularly concerning water availability.

1.3.1 Objectives of the Study

The research objectives are to:

i. Determine the socio-economic and environmental impacts of lithium mining activities on the Arcturus rural communities, with a focus on changes in livelihood patterns and water availability between 2020 and 2024.
ii. Assess the perceptions and attitudes of the Arcturus community towards the mining operations, considering their views on the observed changes in livelihood patterns and water availability.
iii. Examine the coping strategies adopted by the Arcturus rural community to address the socio-economic and environmental impacts resulting from lithium mining activities.
iv. Provide possible strategies aimed at addressing the adverse impacts of the mine on the livelihoods of the Arcturus community and the availability of water resources

1.3.2 Research Questions

To establish the changes in livelihood experiences of the mine's surrounding rural community and water availability due to this new mine's operations the following research questions were explored.

i. How have lithium mining activities impacted the Arcturus rural communities in terms of changes in livelihood patterns and water availability, considering their socio-economic and environmental aspects between 2020 and 2024?
ii. What are the perceptions and attitudes of the Arcturus community towards the mining operations, specifically regarding their views on the observed changes in livelihood patterns and water availability?
iii. Which coping strategies has the Arcturus rural community adopted to deal with the socio-economic and environmental impacts of lithium mining activities?
iv. How can the negative impacts of the mine on both the Arcturus community's livelihoods and water resources potentially be mitigated?

1.4 Significance of the study

In the investigation of changes in the livelihood activities of lithium mining host communities and the environment following the commencement of the mine's operations. This new lithium mine was established as a result of the global lithium boom. Therefore, this study holds significance for society in several ways, addressing the interests of different stakeholder groups in ways that are beneficial to them. In particular, the study makes a substantial contribution to the body of knowledge while also providing valuable insights for mine authorities, local communities, policymakers, and regulatory bodies.

a) Mine Authorities (Current and Prospective)

For existing mine authorities, this study offers insights into how they are perceived by the community, helping them assess potential risks that may arise from community grievances. This understanding enables them to develop appropriate risk management strategies tailored to the level of risk they face. Beyond risk management, the study highlights key concerns and impacts of mining operations on the host community. This knowledge allows mining companies to foster better

relationships with communities, work amicably with them, and secure a social license to operate.

For prospective mine owners, the study provides valuable lessons on the challenges of running a new lithium mine, helping them anticipate and mitigate potential pitfalls.

b) Policymakers and Regulatory Authorities

Regulatory bodies, such as the Environmental Management Agency (EMA), can use the findings from this research study to gain an in-depth understanding of the real-world impacts of new lithium mines, which often extend beyond those anticipated in Environmental Impact Assessments (EIAs). Thus. The study reveals actual impacts that may not have been foreseen during the EIA process. Consequently, the findings that came out of this research serves as a reference point for evaluating EIAs for upcoming lithium mining projects. The study also highlights key areas to focus on when conducting inspections and monitoring lithium mines.

For policymakers, this research study gives empirical evidence that can guide the formulation of policies aimed at ensuring responsible lithium mining practices that balance economic benefits with environmental and social considerations.

c) Impact on Communities

With the rise in numbers of lithium mines being established in Zimbabwe, more communities will continue to be affected by mining activities. Lithium extraction often leads to disruptions in land use and water resources, causing significant hardship for host communities (Sovacool, 2021). This study is, therefore, of great benefit to communities by providing them with insights into what to expect when new lithium mines open in their areas.

Equipped with this knowledge, communities can make informed decisions and actively participate in stakeholder engagement meetings. They can challenge or seek clarification on the new projects from an informed point of view as their contributions will be based on real, previously observed challenges associated with lithium mining projects elsewhere in the country. This puts them in a better position in negotiation for their wellbeing and justice.

d) Contribution to the Body of Knowledge

There has been a gap in scholarly research on the impacts of lithium extractive industries on livelihoods and the environment in Zimbabwe, as no prior studies have explored this issue in the country. Moreover, existing global literature primarily focuses on lithium mining before the current lithium boom. The rapid expansion of lithium mining often results in fast-tracked operations, where due diligence procedures are sometimes overlooked, exacerbating socio-environmental justice concerns (Matanzima, 2024a).

This study provided a unique opportunity to analyse how this accelerated mining process contributes to environmental and social impacts beyond what is typically observed. By uncovering these impacts, the research revealed valuable insights on how this aspect contribute to lithium mining impacts. Information from this research study will inform future studies on lithium mining in Zimbabwe, by laying a strong foundation for further academic exploration in this field.

1.5 Delimitation of the study

This study provides valuable insights into the impacts of new lithium mining projects on communities and the environment, with a specific focus on rural communities surrounding the Arcadia lithium mine. The research was deliberately bounded to this area to enable a detailed and context-specific analysis under defined conditions.

The study primarily examined livelihood changes within the community and environmental impacts, specifically emphasising on water availability. The research sample was limited to residents who had lived in the community before the mine became operational, as they were considered to have firsthand knowledge of the changes that had occurred since the mine's establishment.

While the findings of this study may not capture the full diversity of experiences across all mining regions, they establish an important foundation for understanding the socio-environmental impacts of new lithium projects in Zimbabwe. Building on this groundwork, future research should expand to additional geographical areas and

examine a broader range of environmental and social dimensions to develop a more comprehensive national perspective on lithium mining's effects.

1.6 Ethical considerations of the study

The researcher also addressed ethical considerations, including confidentiality, informed consent, and voluntary participation. Consent forms (Appendix I) were issued to participants and signed in consent to conducting the research. These were signed was after the researcher had thoroughly explained them to the participants. Participants were notified of their right to withdraw from the interview at any point if they felt uncomfortable, ensuring voluntary participation. Confidentiality and anonymity were also assured for all survey participants.

One of the key ethical concerns in qualitative research is the potential for researcher bias, which may influence the quality of interviews (Ruslin *et.al*., 2021). To mitigate this, interview results were cross-checked to ensure that data interpretation was not affected by the researcher's judgment, as recommended by Ruslin *et al*., (2021).

Another source of bias in human-centred research is the possibility of participants altering their responses due to awareness of being studied (McCambridge *et al*., 2014; Christiansen *et al*., 2023). To minimize this effect and build trust, the researcher emphasized the academic nature of the study, clarifying that it was not politically motivated. Additionally, interviews were conducted in a relaxed and informal manner to help participants feel at ease.

Furthermore, the values and beliefs of qualitative researchers can influence studies. Therefore, researchers must remain self-aware of their reactions, reflections, and relationships with participants (Lim, 2024). In this study, personal thoughts and views were deliberately avoided, and open-ended questions were used to allow participants to express themselves fully.

Interview data must be managed confidentially, ensuring that any information that could identify respondents is removed, such as replacing real names with pseudonyms (Nair, 2023). In line with this, participants' names were not recorded in the interview guides, instead, only their respective areas or sections were noted.

1.7 Limitations of the study

In investigating the impacts of lithium mining on the livelihoods of local communities and the environment, time constraints prevented the researcher from visiting all communities surrounding the mine. As a result, only households in communities closest to the mine, those that the researcher perceived to be the most affected, were interviewed. However, every effort was made to ensure that sufficient information was collected to address all research questions. Interviews continued until data saturation was reached.

Although this study focused on a single mine, this in-depth approach provided rich insights into the socio-environmental dynamics of lithium mining and its effects on community livelihoods. These findings serve as an important reference point for understanding similar challenges that may be faced in other mining areas of Zimbabwe. Future research that expands to multiple mining sites would build on this foundation and strengthen the development of broader, evidence-based strategies at a national level.

Finally, the study assessed the mine's impact on community livelihoods and the environment using qualitative methods only. As a result, the extent to which the findings represent the views of the entire population may be limited. To address this, efforts were made to verify findings with multiple participants to ensure that the identified issues were not unique to a single individual. Moving forward, future research should incorporate quantitative data to complement qualitative insights and enhance the reliability of findings.

1.8 Definition of key terms

The following terms are defined to reflect the meaning that they hold in this research

Fast-track: This refers to the rapid expansion and acceleration of lithium mining projects, characterized by a high rate of new mine acquisitions and openings. It denotes an increase in the number of lithium mines being established at a rate significantly faster than before 2021.

Livelihoods: The capabilities, assets, and strategies that individuals or households use to sustain themselves (Muranura *et al*., 2021). This includes all activities related to securing food, water, clothing, shelter, and other essential survival needs (Scoones, 1998; Tirivangasi, 2018; Natarajan *et al*., 2022).

Livelihood activity: The strategies people pursue to meet their needs, such as farming or utilizing natural resources through fishing and hunting.

Rural community (or community): A geographic area located outside towns and cities. In this study, it includes A1 farms, communal lands, and villages.

Sustainable Livelihoods Framework: A guiding tool for analysing rural livelihoods. It categorizes resources into five asset capitals—human, financial, social, physical, and natural; upon which livelihoods are built (Carney *et al*., 1999; UNDP, 2017; Natarajan *et al*., 2022).

1.9 Organisation of the study

This study is made up of six chapters. These are organised as follows

Chapter 1: Introduction - This chapter introduces the study and provides its background. It defines the research problem and highlights the research aim, objectives, research questions, and the significance of the study. Additionally, the delimitation of the study, ethical considerations, and study limitations are explained. Definitions of key terms are provided, along with an overview of the structure of the study. Finally, the chapter summary is given

Chapter 2: Literature Review - This chapter reviews literature on the socio-economic and environmental impacts of lithium mining on the livelihoods of surrounding communities and the environment. It begins with an examination of literature on the global lithium boom, followed by lithium occurrence and mining, from a global perspective down to Zimbabwe. Literature on socio-environmental impacts of lithium mining is then explored. Finally, literature on rural livelihoods and the sustainable livelihoods framework, which is used to assess livelihood changes, are reviewed.

Chapter 3: Research Methodology and Study area - This chapter provides an overview of the study area and discusses the research methodology used to address the research questions. It explains and justifies the qualitative research approach, research design, sampling methods, sample size determination, data collection methods, and data analysis procedures employed in the study. The validity, reliability, and measures taken to eliminate bias are also discussed.

Chapter 4: Results - This chapter presents the research findings, including changes in the livelihoods of communities surrounding the mine and the availability of water following the commencement of lithium mining operations. It also presents findings on community perceptions of the mine and the strategies they are employing to cope with its impacts. Finally, a mitigation framework is presented.

Chapter 5 Discussion - The results of the study are analysed and discussed in this chapter. A comparison is made between the study's findings and existing literature, highlighting similarities and deviations, which are then explained.

Chapter 6: Conclusion and Recommendations - This chapter presents the conclusions drawn from this research and provides recommendations for policymakers as well as suggestions for future studies

1.10 Chapter Summary

This introductory chapter begins by providing background information on the global rise in demand for lithium and how this has led to the rapid opening of lithium mines in Zimbabwe. The associated problems are discussed, highlighting gaps in scholarly literature on the impacts of lithium mining in Zimbabwe, which justified the need for this study.

The research aim is summarized, followed by the objectives designed to achieve this aim. The research questions that guide the study in addressing these objectives are also outlined. The significance of the study is then discussed, detailing the benefits of the research for various stakeholders.

The delimitations of the study, which define its scope and boundaries, are presented, along with the limitations that were beyond the researcher's control. This helps readers understand the extent to which the study's findings can be applied. Given that research involving human participants is associated with ethical considerations, a section on ethical issues is included, explaining how these were managed in this research.

Key terms used in the report are defined to ensure clarity and understanding. The chapter also outlines the organization of the study, providing an overview of its structure. Finally, this summary offers a brief review of the chapter's contents.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter examines literature relevant to the socio-environmental impacts of lithium mining projects on community livelihoods, as well as mining effects on the environment. Literature on the Sustainable Livelihoods Framework (SLF) which the researcher used to analyse these impacts is also discussed in this chapter. In this review, the chapter is thus structured as follows; first, an review of the emergence of the global lithium boom is presented, followed by an overview of lithium occurrence and mining globally, before narrowing focus to Zimbabwe where the study was based. Literature on socio-environmental effects of lithium mining, including perceptions as well as attitudes of communities directly affected by the mining operations is then interrogated. To better understand changes in community livelihoods due to mining, general livelihoods of rural communities are also discussed. Then for context and conceptual guidance on how livelihood impacts can be evaluated, an overview of various theoretical approaches and frameworks for examining mining impacts are reviewed before delving deeper into the Sustainable Livelihoods Framework used in this study. Strategies that societies employ in coping with the negative impacts of shocks and stresses are reviewed, followed by the social networks and community participation approaches that influence social behaviour of communities. Finally, a chapter summary is given to highlight the main literature review findings.

2.2 Understanding the worldwide lithium boom

Globally, there has been growing concerns over change in climate and pollution of the air that is caused by burning fossil fuels (Liu and Agusdinata, 2020). This has resulted in an urgent need to address climate change (Saleth and Varov, 2023; Vivoda *et al*., 2024). World leaders come together and adopted the Paris Agreement in 2016 (UNFCCC, 2018) as well as the SDGs. Specifically in line with climate change are SDGs 13 and 7 which respectively focus on combating climate change and its effects as well as affordable clean energy for all (United Nations, 2018). Apart from these international agreements, IPCC projected varying percentages for greenhouse gas emissions reduction based on 2019 levels which will enable attainment of the 1.5^{o}C limit warming by different timeframes (IPCC, 2023).

One of the key strategies in curbing climate change has been the shift from the use of fossil fuels to use of clean energy inherent with low carbon emissions (Liu and Agusdinata, 2020; Tsivadzea *et al*., 2023). Much of this clean energy comes from renewable sources for instance wind and solar which are also intermittent energy sources (Hancock *et al*., 2017). As these sources do not generate electricity all the time, they require substantial energy storage solutions to store excess energy for use when conditions do not allow its generation (Vivoda *et al*., 2024). Apart from energy storage for these intermittent energy sources, Agusdinata, *et al*., (2018) identified the transport sector as another target area for clean energy transition. This was backed by their study in 2018, in which they found that about 90% of vehicle in the US used fossil fuels, contributing 25% of the total emissions of greenhouse gases, positioning the transport industrial sector as a significant contributor towards climate change (Agusdinata *et al*., 2018). In support of this need to target the transport sector for decarbonization, the European Commission launched the European Green Deal in 2019 which aims at increasing the usage of electric vehicles to thirty million by 2030 and have almost all vehicles zero-emission by 2050 (Saleth and Varov, 2023). Several other authors have noted transitioning passenger cars to renewable energy sources as one of the most promising and crucial steps to reducing GHG emissions (Liu and Agusdinata, 2020; Dorn and Gundermann 2022; Saleth and Varov, 2023).

From the above review, it is evident that the global shift towards clean energy has thus led to the increased interest in electric vehicles and energy storage technologies (Liu and Agusdinata, 2020; Dorn and Gundermann, 2022; Vivoda *et al*., 2024). Consequently, this growing interest has resulted in rising demand for clean energy, leading led to a corresponding increase in lithium extraction in the past decade (Liu and Agusdinata, 2020). This is further acknowledged by the International Energy Agency (IEA) who point that lithium is essential in today's rapidly growing clean energy technology (IEA, 2021). This is because lithium is a key mineral in this energy transition as it is used in the manufacturing of lithium-ion batteries, an essential component of clean energy movement (Hancock *et al*., 2017). This view of the increase in demand for lithium, is supported by other authors who aligned the surge in lithium demand to the race to achieve net zero emissions (Martin *et al*., 2017; Matanzima, 2024b). The demand for electric vehicles drives the lithium minerals

demand as sales of these vehicles translate directly into the need for batteries (Agusdinata *et al*., 2018). Lithium batteries not only fulfil this need for energy storage, but also provide cleaner and more sustainable storage solutions (Sterba *et al*., 2019; Vivoda *et al*., 2024).

Among all transition minerals, lithium is considered the most critical and preferred choice for energy storage technology (Sterba *et al*., 2019). This is because of its high energy density, long life cycle, efficient discharge capacity (Vivoda *et al*., 2024). Apart from these advantages, lithium is also preferred for its lightweight nature (Dorn and Gundermann, 2022), high electrochemical potential (Sterba *et al*., 2019), and cost-effectiveness (Pichler *et al*., 2017). For its use in electric vehicle battery systems, lithium has become an indispensable resource, and thus fuelling the current lithium rush (Pichler *et al*., 2017). Although the long-term demand for lithium is uncertain due to ongoing technological advancements that could lead to cheaper alternatives, lithium's unique properties make it likely to remain a key component in battery production (Church and Crawford, 2020; Slattery *et al*., 2023).

While, lithium has been extracted for several decades for applications such as ceramics and lubricants (Forbes, 2008). In 2019, Sterba *et al*., acknowledged lithium's use in making glass, ceramics, lubricating greases, and other applications, with battery manufacturing using 56% of the lithium. By year 2023, Tsivadze *et al*., noted a sharp rise in its use in lithium use pointing that of all the lithium that was produced 80% was used in battery manufacturing. This growth in relevance for the resource was echoed by Liu and Agusdinata, (2020), who said since 2000, lithium production has been increasing by approximately 20% annually due to its rising global demand. Due to this growing popularity and demand lithium has gained in recent years, it has since been nicknamed "white gold" (Dorn and Gundermann, 2022).

Dorn and Peyre, (2020) pointed not only to significantly increase in lithium demand in recent decades but also to its continuous increase in the future. This observation is supported by Sterba *et al.*, (2019) who noted concerns regarding the discrepancy between lithium production and consumption in the EU, where they indicated that the resulting undersupply of lithium was expected until 2045. This view was echoed by Pavlovic and Chivanga, (2023) who indicated that demand for lithium is projected to

continue rising due to the global push for carbon emissions at net-zero by 2050. The International Energy Agency (IEA) specified the projected increase to 6 times more in 2040 than today so as to meet this global net zero 2050 (IEA. 2021). This skyrocketing demand for lithium driven by climate mitigation efforts was also noted by Matanzima, (2024a). Sterba *et al*., (2019) specifically linked this surge in lithium demand to rising global production of electric vehicles as a strategy towards climate change mitigation.

As the demand for lithium has been increasing, so has its extraction expanded significantly (Liu and Agusdinata, 2020). This was noted earlier by Sterba *et al*., (2019) who contends, continued demand for lithium will further drive its extraction. Evidence suggesting that lithium mining will continue to accelerate was noted (Albizua *et al*., 2024). Dorn and Gundermann, 2022 as well as Mkodzongi, 2024) pointed to new lithium mining projects already being reported to have been emerging worldwide in recent years. This observation aligns with Saleth and Varov (2023), who state that the cumulative global demand for lithium has resulted in the mushrooming of new projects in its mining. Apart from this, the increased demand in clean technology has also led to a rise in lithium market prices (Dorn and Gundermann, 2022) making its extraction more attractive and attracting more players (Mkodzongi, 2024). However, on another note, as more lithium mines are developed, demand is expected to continue rising, with prices eventually stabilizing (ANRC, 2021).

Mining companies, governments, and media outlets argue that lithium extraction is both necessary and urgent to achieve carbon neutrality (World Bank, 2020). However, the rising worldwide demand for lithium elevates concerns about its supply, particularly since lithium mineral reserves and production are concentrated in only a few countries (Vivoda *et al*., 2024).

2.3 Lithium occurrence and mining

Historically, lithium extraction was concentrated in Australia and the Lithium Triangle, which consists of Argentina, Chile, and Bolivia (Dorn and Peyré 2020; Dorn and Gundermann, 2022; Vivoda *et al*., 2024). China, another key player in the lithium industry has been the dominant processing part of it (Kashwan and Jayaram, 2023). The Lithium Triangle contains more than half of the world's known lithium reserves (Dorn and Gundermann, 2022; Kashwan and Jayaram, 2023). Globally, lithium

mineral occurs either in salt pan-based deposits, hard rock, or clay formations from which it can be extracted in its raw state (Sterba *et al*., 2019; Vivoda *et al*., 2024).

Lithium can also be recovered from recycling and a process that can alleviate some of the pressure to mine (Sterba *et al*., 2019; Church and Crawford, 2020) as studies have shown that lithium supplies will significantly deplete by 2060 (Manberger and Stenqvist 2018). However, there has been some consensus among authors that to date, collecting of lithium products for recycling have been very low (Church and Crawford, 2020). Sterba *et al*., (2019) attributes this low recycling contribution to the global supply to the vast reserves and resources currently available, making recycling unattractive. Regardless of the low contribution, recycling is expected to account for approximately 25% of total lithium production by 2050, (Sterba *et al*., 2019). This therefore means that demand for lithium extraction will continue to increase.

While the Lithium Triangle has been mining lithium for decades, its increasing relevance in clean energy technologies has sparked renewed interest in lithium deposits over the last two decades (Dorn and Gundermann, 2022). Consequently, there has been ongoing discoveries of lithium deposits worldwide. In Africa, Zimbabwe, Namibia, Ghana, the Democratic Republic of Congo (DRC), and Mali have emerged as key lithium producers in the continent (Cleote *et al*., 2023; Chen *et al*., 2024). In support of this discovery, Parker, (2024) says, notable exploration and development activities have been observed in the DRC, Namibia, and South Africa. Chen *et al*., (2024) further points out that Zimbabwe, the DRC, and Mali hold considerable lithium deposits that have yet to be fully explored, suggesting that the continent's lithium reserves could be even larger than currently estimated. As at 2023, Cleote *et al*., noted that in Africa, only Zimbabwe and Namibia had begun extraction and exporting of the raw ore for further processing.

In Zimbabwe, lithium mining began in the 1950s (ZELA, 2023), with a single mine operating in the sector until recently (Goodenough *et al*., 2021; Mkodzongi, 2024. However, due to the global lithium boom, several new lithium mining projects have emerged (Shen and Zhou, 2023; Matanzima, 2024a), leading to what has been described as a "lithium rush" (ZELA, 2023). Matanzima (2024c) suggests that Zimbabwe’s lithium deposits remain largely untapped, and the current ongoing

exploration is likely to result in the development of even more mining projects in the coming years.

2.4 Overview of Lithium mining in Zimbabwe

The ongoing worldwide transition to energy systems that are low in carbon has significantly increased the demand for lithium (Vivoda *et al*., 2024). This has created a historic opportunity in Zimbabwe's lithium mineral resource (Shen and Zhou, 2023) as the country is rich mineral resources base that includes lithium (Mkodzongi, 2024). Like in Australia, Zimbabwe's lithium deposits are predominantly found in hard rock pegmatites rich in lepidolite, spodumene, and petalite (Vivoda *et al*., 2024). Extraction is primarily conducted through open-cast mining since lithium-bearing rock is located near the surface (Prospect, 2021). Hard rock mining involves conventional extraction methods to obtain spodumene, followed by chemical processing to release lithium (Vivoda *et al*., 2024). Currently, Zimbabwe exports these concentrates to China for further processing (Shen and Zhou, 2023).

This rising global demand has also opened up the much-needed economic opportunities for the country, which can transform its economy (Mkodzongi, 2024). This view is supported by Shen and Zhou, (2023) who says, lithium mining is a potential solution one of Zimbabwe's biggest economic challenges on securing adequate financial resources, and (Shen and Zhou, 2023). In capitalising on this opportunity, the country's president set a national goal in 2023 for achieving $12 billion in mining revenue, backing this ambition on the untapped lithium reserves (Government of Zimbabwe, 2023). In line with this goal, the government aims to contribute 20% of the world's total lithium supply (Shen and Zhou, 2023). Efforts towards achieving this goal have already been evident on the ground with the government implementing investor-friendly policies, like the removal of the 51% local ownership requirement for mining entities (Shen and Zhou, 2023). Additionally, Mkodzongi, (2024) highlighted the establishment of the Zimbabwe Investment and Development Agency (ZIDA), a one-stop shop where investors can quickly register their mining operations. All these efforts to attract foreign investment, could explain why there has been a rapid expansion of lithium mining projects across the country.

The fast-tracked acquisition and exploration of lithium claims have led to significant growth in Zimbabwe's lithium industry. The country's lithium export revenue rose from $1.8 million in 2018 to $209 million by September 2023 (Mining Weekly, 2023), positioning lithium as the third-highest mineral export after the platinum group metals and gold (Pavlovic and Chivanga, 2023).

Although lithium mining is not new to Zimbabwe, Bikita Minerals was the country's only operational lithium mine until 2021 (Mkodzongi, 2024). At that time, it was Africa's only fully established and active lithium mine (Dittrich *et al*., 2019; Goodenough, 2021). The African Natural Resources Centre (ANRC) (2021) confirmed that Zimbabwe mined and exported raw lithium ore only from the Bikita Minerals mine. By the end of 2024, multiple lithium mines had become operational as shown in table 1 below.

Table 1, Current operational lithium mining projects in Zimbabwe (Shen and Zhou, 2023; Matanzima, 2024b)

Project name	**Location province**
Arcadia lithium mine	Mashonaland east
Bikita Mining Company	Masvingo
Sabi Star	Mashonaland east
Zulu	Matebeleland
Kuvimba Mining House Mberengwa- Sandawana	Midlands
Kamativi Mining Company	Matebeleland north
Premier African Minerals Resources Limited	Mutare

Currently, Zimbabwe is leading the lithium race in Southern Africa (Parker, 2024) with the highest number of lithium projects in Africa (Pavlovic and Chivanga, 2023). On a global scale, some sources rank Zimbabwe as the fifth-largest holder of lithium mineral reserves in the world (Mkodzongi, 2024), while others place it in sixth position (Matanzima, 2024a). Regardless of the exact ranking, these estimates highlight the vast potential of the country's lithium resources. Like Shen and Zhou (2023), Mkodzongi, (2024) attributes this leading position to the global lithium rush, pointing out that investors have since swiftly entered the lithium business. In support of this view, Pavlovic and Chivanga, (2023) say many of these investors have either acquired

mining entities, purchased lithium claims, or formed joint ventures with local businesses and government entities. Chinese companies have been noted as making the most significant investments in the country (Matanzima, 2024c; Mkodzongi, 2024). Experts suggest that if Zimbabwe fully exploits its lithium reserves, it could meet twenty percent of the world's total lithium requirement (Pavlovic and Chivanga, 2023).

Due to the country's lack of technological infrastructure and weak industrial base, Zimbabwe continues to export raw lithium rather than refining it domestically (Mkodzongi, 2024). Despite all this, Zimbabwe's focus has been on the economic benefits that lithium mining can bring (Shen and Zhou, 2023). Lithium mining has the potential to reduce unemployment, improve infrastructure, and increase tax revenues (Mkodzongi, 2024). However, there has been little attention offered to the human rights, social, and environmental consequences of lithium mining (ZELA, 2023). The rapid expansion of mining projects in Zimbabwe, with durations that are way contrary international standards may exacerbate adverse effects on local communities and ecosystems. According to the IEA, their analysis indicated that mining projects take long to develop, taking on average 16.5years to move from discovery to first production (IEA, 2021).

2.5 Institutions for lithium governance in Zimbabwe

Lithium mining operates within a complex system influenced by both social and environmental factors, involving numerous interactions among various stakeholders, including the government, companies, local communities, and ecosystems (Petavratzi *et al*., 2022). To fully understand the social and environmental changes occurring in an area, it is essential to consider the institutions that govern how lithium is extracted and managed (Petavratzi *et al*., 2022). Zimbabwe does not have a national policy specifically addressing lithium (ZELA, 2023). Instead, the Mines and Minerals Act (Chapter 21:05) of 1961, which has undergone several amendments over the years, regulates all mining activities in the country. The Act governs mining operations, including licensing and the acquisition of mining rights. According to Section 2 of the Act, mining rights are vested in the President and administered through the Ministry.

Similar to Chile, where lithium is classified as a strategic mineral resource under direct government control (Petavratzi *et al*., 2022), Zimbabwe also designates lithium as a

strategic mineral. The Second Schedule of the Mines and Minerals Bill, gazetted in February 2023, added lithium to the list of strategic minerals. Apart from this, in response to the lithium rush, the Government of Zimbabwe introduced Statutory Instrument (SI) 213 of 2022, which was later repealed by SI 5 of 2023 and amended by SI 57 of 2023. These legal instruments banned the exporting lithium in its raw state to promote local beneficiation of the mineral prior to export. This aligns with Vision 2030, which aims to transform Zimbabwe into an empowered, wealthy and upper-middle-income society by the year 2030.

In addition to the Mines and Minerals Act, several other pieces of legislation regulate different aspects of mining activities. Notably, the Environmental Management Act (Chapter 20:02 of 2002) and its subsidiary regulations require that all listed projects, including mining activities, undergo an Environmental Impact Assessment (EIA) before commencement. While regulators in Zimbabwe are strict about requiring EIAs prior to project initiation, monitoring compliance with the plans outlined in the EIA remains a significant challenge (ZELA, 2023). Water abstraction is covered under the water Act, chapter 20:24. The fragmented and varied governance frameworks on lithium create room for improvement with regards to the consistent and systematic gathering and analysis of the data on lithium plus access to it by the public (Petavratzi *et al*., 2022).

2.6 Socio-environmental impacts of lithium mining

As previously noted, the global increase in demand for clean energy minerals like lithium has led to accelerated extraction (Albizua *et al*., 2024; Matanzima, 2024a). Subsequently, this has resulted in the multiplication of mining projects in countries with rich mineral resources (Saleth and Varov, 2023). Mining activities cause land changes with consequences for the environment and the livelihoods of local communities (Wilson *et al*., 2022). As a result, communities living on mineral-rich lands are exposed to these environmental and social sustainability issues in several forms.

2.6.1 Environmental impacts

Lithium mining projects have been connected with several negative consequences on the environment and livelihoods of societies. Particularly, extraction and purification of lithium generate substantial quantities of residual waste ponds and tailings

(Schomberg *et al*., 2021, in Vivoda *et al*., 2024), environmental degradation (Global Witness, 2023), deplete and contaminate water reservoirs (Cleote *et al*., 2023), pollute the air, and reduction in biodiversity (Kashwan and Jayaram, 2023). In agreement to these impacts, Liu and Agusdinata, (2020) noted impacts associated with water availability, biodiversity, and, loss of access to farmland and ecosystem degradation. According to Kashwan and Jayaram (2023) report that extracting lithium from hard rock consumes 170 cubic meters of water per ton of lithium extracted and releases 15 tons of carbon dioxide. This aligns with Pichler *et al*., (2017) who concur that lithium extraction demands large quantities of fresh water resulting in reduced aquifer levels.

In Chile and Siera Leone, excessive water consumption by lithium mining projects, was found to occur on shared resources (Liu and Agusdinata, 2020; Wilson *et al*., 2022). This brings to fore another environmental issue stemming from the close interdependent lithium mining and surrounding communities are who sharing resources such as water and land (Liu and Agusdinata, 2020). Worldwide, natural resources are essential is sustaining livelihoods for rural communities (Nawrotzki *et al*., 2012; Manduna, 2023). Lithium mining disrupts relationships between humans and their environment, negatively impacting livelihood activities like cattle herding, farming, and beekeeping (Canelas and Carvalho, 2023).

On another note, mining sites typically occur in areas covered by forests and/or on land belonging to indigenous populations (Albizua *et al*., 2024). Clearing the land for mining lead to deforestation and ecosystem disruption (Dorn and Gundermann, 2022; Albizua *et al*., 2024). Consequently, affecting the livelihoods of rural societies that heavily rely on resources derived from the land (Wilson *et al*., 2022). Also, environmental degradation disrupts local communities with respect to their livelihoods as they depend on the ecosystem for subsistence, subsequently increasing poverty and displacement (Ayuba, 2012, in Siloko, 2024). Further to this, in their study in Siera Leone, Wilson *et al*., (2022) revealed restricted access to farmland and pollution of fertile land.

Due to these numerous environmental impacts witnessed in mining areas that negatively impact local communities, concerns have thus arisen over the formation of new sacrificial zones in the name of greening the economy, (Scott and Smith, 2017;

Sovacool *et al*., 2021; Saleth and Varov, 2023). Studies interrogating the notion of green extractivism have questioned whether mineral-intensive growth strategies for greening the economy can ever be truly sustainable (Giglio, 2021), considering that promoting clean energy through mining of minerals often leads to environmental degradation and social inequality (Albizua *et al*., 2024). In a study in Chile, Tscherning and Chapman (2020) concluded that current lithium mining activities are far from being ecologically and socially sustainable, as anticipated by the green economy initiative. Additionally, it is important to recognise that mining projects have limited lifespans; hence, creating long-term local value is equally crucial (Dorn and Gundermann, 2022).

2.6.2 Social sustainability impacts

Several social impacts have also been linked to lithium mining. In a study by Diaz *et al*., (2023) in Argentina, they found that lithium mining was frequently linked to social injustices and conflicts over water consumption (Diaz *et al*., 2023). Conflicts over water rights have been reported between local communities and mining companies in Chile (Dorn and Gundermann, 2022). Key to note is that, livestock farming and crop production, crucial livelihood activities for many rural communities (Nawrotzki *et al*., 2012), are highly dependent on water availability. Therefore, lithium extraction significantly threatens these two livelihood activities (Pichler *et al*., 2017). As governments continuously grant mining rights to companies, more pressure continues to be exerted on already limited water resources, a situation that has already been observed in Chile (Liu and Agusdinata, 2020).

Devastating social effects, such as household displacement from ancestral lands, and human rights abuses have also been noted in new lithium mining projects (Matanzima, 2024b). In agreement to this, Wilson *et al*., (2022) state that acquisition of land for mining operations leads to the displacement and relocation of communities residing in mining areas. Pichler *et al*., (2017) further note that such displacements affect numerous families from the specific communities. In most cases, these are forced displacements (Matanzima, 2024a). These displacements also result in losses of several livelihood activities. A study by Matanzima (2024b) found that displaced communities in Buhera, Zimbabwe, lost farmland, grazing land, fruit trees, and water resources due to lithium mining. In Papua New Guinea, displacement and resettlement resulted in income loss and loss of cultural identity (Bainton *et al*., 2022; Kemp *et al*.,

2017), along with reduced grazing land (Wilson *et al*., 2022). Unfortunately, due to land scarcity, displaced farming communities are often relocated to areas near or within forests, where they reestablish farms (Owen and Kemp, 2015). Matanzima (2024b) asserts that, in the absence of due diligence, the urgency for worldwide decarbonisation and fast-track lithium extraction will continue to drive community displacements.

Although displaced communities are often financially compensated for losses incurred, numerous studies have found this compensation to be inadequate (Sovacool, 2021; CNRG, 2023; Matanzima 2024a). Compensation has also been provided for environmental interventions and the use of territory and its resources (Dorn and Gundermann, 2022). Matanzima (2024b) reports that monetary compensation provided to affected communities did not meet their expectations, as no consideration was given to the actual value of their properties and land. While Zimbabwe's Mines and Minerals Act (Chapter 21:05) mandates compensation for affected communities by mining corporations, corruption and weak governance have hindered its proper implementation (Matanzima, 2024a).

On the positive side, lithium mining can create jobs for communities surrounding the mine (Dorn and Gundermann, 2022), provide direct income, and indirectly promote other local economic activities (Liu and Agusdinata, 2020). Similarly, Wilson *et al*., (2022) found that corporate mining not only creates employment in both mining and related industries, it also generates market opportunities for local residents from increased sale of food crop, thus altering the livelihoods of the locals. In contrast, Liu and Agusdinata (2020) discovered that, despite several job opportunities created by the mine, the number of locals employed remained very low. This view is supported by Canelas and Carvalho (2023) who contended that the notion of job creation and economic development in mining communities is often used as a ploy to gain local acceptance of extractive activities at the expense of local communities and their environments.

Amidst these concerns, increased social activism against lithium mining operations has been reported in Chile (Liu and Agusdinata, 2020). Similarly, in their study in Portugal, Salev and Varov (2023) found that nearly all residents of villages near a mine opposed the project, perceiving it as a threat to their agricultural livelihoods. This

resistance by locals and the increasing environmental impact of lithium mining have led global car manufacturers, including Mercedes-Benz and Volkswagen, to seek lithium sources with the lowest socioecological impact (Kashwan and Jayaram, 2023).

Other issues associated with lithium mining include the exhumation of graves, causing emotional distress (Matanzima, 2024c); social well-being and imbalanced migration flows, with more people moving into mining communities than leaving (Liu and Agusdinata, 2020) and ethical concerns regarding cultural degradation (O'Faircheallaigh, 2008). Additionally, lithium extraction has been noted to carry political implications and contribute to community fractures (Matanzima, 2024a). Furthermore, mining of lithium threatens the survival of local communities as it usually disrupts their traditional production modes, which point to their identity (Pichler *et al*., 2017). All these impacts highlight how the escalation of need for lithium-based products bring challenges, spanning from concerns at local mining site to broader global sustainability concerns (Albizua *et al*., 2024).

While communities face these significant negative impacts, several studies indicated that several of them felt they were not expressively included when it comes to making decisions on issues arising from mining projects that affect them (Pichler *et al*., 2017; Canelas and Carvalho, 2023; Matanzima, 2024a). Lack of consultation and participation was also noted by Milgroom and Claeys, (2024). In support to this observation, Saleth and Varov (2023) found that communities felt restricted in the making of decisions regarding projects that affect their livelihoods directly and were not given the right to refuse the projects. Limited consultation on the environmental impacts of lithium mining was also observed in Zimbabwe (ZELA, 2023). Instead of engaging with local communities, mining companies often bypass locals and negotiate with governments and local leaders on their behalf (Pichler *et al*., 2017; Matanzima, 2024a). In extreme cases, studies have established that companies use unethical means like deception, manipulation, coercion, and misinformation to gain consent and access to community land (Canelas and Carvalho, 2023; Milgroom and Claeys, 2024). Over and above, these challenges, Saleth and Varov, (2023) found that local communities often feel powerless to assert their demands at the national level regarding developments affecting their land.

All this is against the UN Declaration on the Rights of Indigenous Peoples in which the right to free, prior, and informed consent, for affected communities and the ability to take part in decision-making and gaining favourable outcomes are recognised (UN, 2007; Matanzima, 2024a). Matanzima, (2024b) points out that meaningful consultation and participation can help alleviate the social and environmental effects of mining projects. He further advices that consultation can be done particularly in decisions regarding resettlement sites, compensation structures, and impact assessments.

Therefore, cautious consideration of the consequences of new mining developments is required, as the quest for short-lived profits may aggravate the impulse to neglect the long-lasting consequences at the local level (Shen and Zhou, 2023). A more balanced approach is required, one that integrates technological advancements in climate mitigation with environmental protection and social equity (Slattery *et al.,* 2023). This will also go a long way in achieving SDG 12 on responsible consumption and production which sets high requirements for the responsible supply of raw materials (Petavratzi *et al*., 2022). While Environmental Impact Assessments (EIAs) are conducted at the project's conception to understand potential environmental and social impacts, gaps remain in assessing the actual consequences of lithium extraction and processing on communities (Albizua *et al*., 2024).

2.7 Mining impacts on community livelihoods in Zimbabwe

Apart from the impacts of lithium mining, several studies have been conducted in Zimbabwe on the effects of mining activities on the livelihoods of nearby communities. In particular, the discovery of mineral resources has often been linked to the displacement of communities, as was the case with the diamond reserves in Marange, which led to the relocation of the Chiadzwa people from their ancestral land (Gukurume and Tombindo, 2021).

Manduna (2023) provides further analysis of these mining-induced displacements, noting that 4,321 Chiadzwa families were relocated to Arda Transau Farm; 224 families (and 265 graves) were moved due to Murowa Diamonds to the Shashe area in 2005; and in 2002, Anglo American’s Unki Platinum Mine forcibly displaced 40 households to Shurugwi. Beyond the physical relocations, Chiadzwa communities lost

houses, boreholes, gardens, family graves, and other valuable assets (Gukurume and Tombindo, 2021).

Similarly, Kativu and Oskarsson (2021) reported that the community in Mutoko suffered severe impacts from black granite extraction, including broken bridges, damaged roads and fields, cracked houses, polluted air, hazardous living conditions, and significant loss of land. Unfortunately, most of these communities have not received adequate compensation for their losses (Gukurume and Tombindo, 2021; Kativu and Oskarsson, 2021). As a result, many villagers across the country continue to live in fear of displacement due to mining operations (Manduna, 2023).

2.8 Livelihoods in rural communities

Talking of livelihoods, Maramura *et al*., (2021) defines these as assets, capabilities, and strategies people use in making a living. More explicitly, FAO (2020) defines livelihoods as the activities that people do to earn a living as well as the different elements that contribute to, or affect, their ability to ensure a living for themselves and their household. In view to this, Tirivangasi (2018) see all activities associated with sourcing what to eat, water, clothing, shelter, and all essential requirements for survival at the individual and/or household scale as livelihoods.

In rural communities, the majority of people highly depend on natural resources and oftentimes pursue diverse livelihood activities, including off-farm employment, farming, and fishing, hunting, and gathering (Nawrotzki *et al*., 2012; Gukurume and Tombindo, 2021; Manduna, 2023). This narrative is echoed by Gukurume and Tombindo, (2021) who indicated that in these communities, livelihoods are based primarily on access to natural resources like land and water for agricultural, livestock production, and small-market activities. Any shock or change that people encounter can affect not only their livelihoods but also the sustainable usage of natural resources (DFID, 1999; Chuong *et al*., 2024). To clarify the impacts further, DFID (1999) points that these shocks can pressurise people to leave their homesteads, destroy their assets or people to dispose their assets prematurely in a way cope with the effects.

2.9 Theoretical Approaches and frameworks

In order to assess impacts of changes or shocks to mining societies, several frameworks have been developed. These include the sustainable livelihoods framework, social ecological systems framework (SES), rights-based approach, resource curse theory, resilience framework, social license to operate (SLO) theory, corporate social responsibility (CSR) and shared value theory among other. These are all applicable to different situations. While this study used the sustainable livelihoods framework and will be discussed in greater detail, some of the above frameworks will also be discussed.

- The SES framework is used where there is need to determine linkages between human variables and how these affect the natural resource system (Partelow, 2018).

- Stakeholder Theory - This theory states that companies have diverse stakeholders whose interests must be protected, as these stakeholders influence the company's ability to achieve its objectives (Brin and Nehme, 2019). Therefore, companies should not focus solely on shareholders but also consider all parties affected by their operations, including local communities (Zarefar and Sawarjuwono, 2021) and ensure their representation at board level (Brin and Nehme, 2019). In using this theory, to determine mine impacts on communities, issues around community representation and implementation of their concerns at board level are therefore considered (Brin and Nehme, 2019).

- Resource Curse Theory - This concept describes a situation where a resource abundant country fails to leverage its natural resources to achieve sustained, socio-economic progress and peace for its citizens (Narh, 2023). This stems from mismanagement of natural resource rents, leading to social conflicts, corruption, economic instability, unrest, and long-term environmental damage (Hassan, 2021). At the community level, the proximity of abundant natural resources often negatively impacts the social and economic well-being of local populations (Murrey and Jackson, 2019). This theory is commonly assessed using macroeconomic pointers such as growth in the economy, gross domestic product (GDP), and

financial growth, however, these measures fall short when it comes to clearly reflecting on the actual livelihoods of regular citizens (Narh, 2023). As a result, the theory often overlooks the socio-environmental effects of extracting resource on local communities, which does not align with the objectives of this study.

- Corporate Social Responsibility (CSR) this is about the voluntary and unregulated practices undertaken by corporations to improve social and environmental conditions (Brin and Nehme, 2019). CSR activities include charitable initiatives, ethical labour practices, volunteering, and environmental efforts aimed at benefiting society at large (Freemarn and Dmytriyev, 2017). As the core idea behind CSR is that corporations should on profits as well as addressing environmental, social, and economic issues (Zarefar and Sawarjuwono, 2021) to build good relationships between corporations and the public, (Zarefar and Sawarjuwono, 2021). Using this theory to analyse company impacts on society will mean focusing on the perceptions of the communities on the company and the activities done by the company to the community.

- Social License to Operate (SLO) Theory - this refers to the continuing acceptance or endorsement of the operations of an entity by the local community affected by it, as well as by other stakeholders who can influence its profitability (Moffat *et al*., 2015; Stuart *et al*., 2023). This acceptance is earned through ethical behaviour, transparency, and meaningful community engagement (Kamenopoulos and Agioutantis, 2021). The SLO functions as an unwritten social contract between a company and the communities in which it operates (Moffat *et al*., 2015; Eerola and Komnitsas, 2023). While the concept is most commonly associated with companies in natural resource and extractive industries, such as mining (Kamenopoulos and Agioutantis, 2021), it continuously evolves to reflect the quality and strength of the relationship between the company and its stakeholders (Stuart *et al*., 2023). Again, using this theory to assess livelihood impacts of mining activities will not explicitly indicate which activities have been affected.

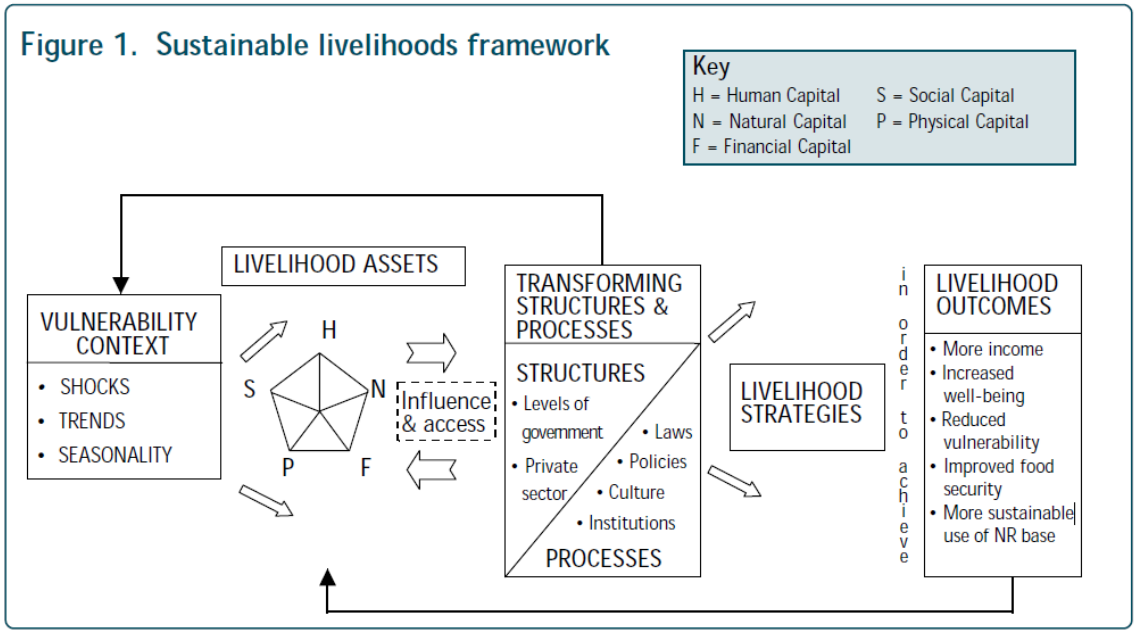
As the aim of this research study was to analyse changes in livelihoods that came about following the onset on the new mine, the SLA was found to be the most ideal.

The framework has the ability assess the impact of development projects on the livelihoods (Ashagrie, 2021) and their contribution to livelihoods (DIFR, 1999) which is what this study aimed to explore. Apart from this, it has also been successfully used in several livelihood studies (Nawrotzi *et al*., 2011; UNDP, 2017; Siloko, 2024).

2.9.1 Sustainable Livelihoods Framework

The sustainable livelihoods framework (SLF) is a guidance tool that was developed for analysing rural livelihoods (Nawrotzki *et al*., 2014; Natarajan *et al*., 2022). The framework is flexible, it provides a guidance structure without necessarily giving a mandatory sequence of analyses to follow (Carney *et al*., 1999; Natarajan *et al*., 2022). It originated from the sustainable livelihoods concept which came into being during the 1990s and 2000s following the UN agenda on poverty reduction (Nawrotzki *et al*., 2014; Natarajan *et al*., 2022) as well as from the global Millenium Development Goal of halving poverty and increasing wellbeing by 2015 (Brocklesby and Fisher, 2003). To achieve the agenda, several development agencies and national governments began creating and adopting many different tools and strategies for poverty reduction (Nawrotzki *et al*., 2014; UNDP, 2017; Natarajan *et al*., 2022). The concept of a framework was later brought about by the publication in the second IDS working paper by Scoones in 1998 (Natarajan *et al*., 2022). The framework highlights main factors that impact on people's livelihoods and how these are connected (DFID,1999; UNDP, 2017).

Several applications of the SLF have been discovered (Bank, 2005; DIFD, 2019; Natarajan *et al*., 2022). Key to this research, the framework helps in better understanding how households acquire and manage various assets to sustain their livelihoods (Muranura *et al*., 2021) and offers a broad perspective on shifting livelihoods (Murray, 2000 in Bank, 2005). Top to the SLF, is the conception that the livelihood choices of rural households is influenced by the availability of diverse capital assets and the interaction between these and the livelihood strategies (Nawrotzi *et al*., 2011). Fig 1 below shows a diagrammatic illustration of the SL framework



Source: DFID, 1999

The SLF groups resources into five classes called asset capitals (Carney, *et al*., 1999; Nawrotzki *et al*., 2014; *Natarajan et al., 2022*), upon which human livelihoods are made (DFID, 1999). These capitals include human, financial, social, physical, and natural (Carney *et al*., 1999). These five classes have been further explained by several authors (DIFD, 1999; Nawrotzi *et al*., 2011; Muranura *et al*., 2021) to mean the following. Financial capital, these are financial assets that people use to reach livelihood objectives, including savings and credit. Human capital these are skills, knowledge, education, and labour that collectively allow people to pursue diverse livelihood strategies and attain their livelihood objectives. Social capital, these are social resources like networks and relationships of trust upon which humans rely in the chase of their livelihood aims. Physical capital, these are basic infrastructure and producer goods required by people in supporting livelihoods, such as transport, shelter, and infrastructure. Natural capital, these are natural resource stocks from which resources flow, as well as environmental services from which livelihoods are derived. Stocks include resources such as water, air, and soil, while environmental services include the hydrological cycle and pollution sinks.

How communities access these capitals, the degree of capital diversity, and the level of access can be affected by stresses and shocks (Nawrotzki 2014; Chuong *et al.,*

2024). In agreement, DFID (1999) states that shocks (the external environment where people live and have no control over) determine assets. Access to these assets combines in several different ways to create positive livelihood outcomes (DFID, 1999; Natarajan *et al.,* 2022). A single asset can produce numerous benefits (DFID,1999). Institutions, policies, and processes also shape how people can have access to assets and livelihood activities (Chambers and Conway, 1992; *UNDP, 2017*).

2.10 Sustainable Livelihoods

Livelihoods are vulnerable to shocks and stresses (Chambers and Conway, 1992; Chuong *et al.,* 2024). Stress referring to pressures typically predictable, unceasing, and cumulative, such as declining resources like water tables, declining farm sizes, and having to go further and longer for fewer fuel, grazing land, or water, while shocks are unexpected, immediate, unpredictable, and distressing impacts like huge fires, severe floods and droughts (Chambers and Conway, 1992). A livelihood can be considered sustainable if it can withstand and recuperate from shocks and stresses, preserve or improve its capacities and assets over time, without undermining the natural resource base upon which livelihoods depend (Muranura *et al*., 2021). Sustainable livelihoods may be achieved through land ownership, rights to grazing, stable employment with adequate wages, among other means (Chambers and Conway, 1992).

Variations in context has consequences on the livelihood and livelihood mitigation strategies at household scale (Scoones, 1998; Chuong *et al.,* 2024). Access to the five capitals is influenced by the vulnerability context a household is exposed to (Natarajan *et al*., 2022). The external environment, including shocks, trends, and seasonal shifts, can destroy assets and influence livelihood strategies (DFID, 1999; Chuong *et al.,* 2024). People change livelihoods when faced with stress and shocks to live with and adapt to the change/impact (Muranura *et al*., 2021). In agreement, UNDP (2017) states that households and individuals pursue diverse activities, income sources, and acquire different assets in response to push and pull factors.

2.11 Coping strategies

Strategies are the choices and activities people undertake to achieve their livelihood goals (DFID, 1999), and these strategies can be implemented in combination. Several

factors such as being born into a family of potters, gender, inheritance, the society in which one lives, and the economic and ecological environment determine the strategies people adopt to make a living (Chambers and Conway, 1992). These livelihood adaptation strategies aim to enhance security and wealth while reducing vulnerability and poverty (Yaro, 2006; UNDP, 2017). The strategies can be grouped into several categories, including intensification of land use, diversification of livelihoods, abandonment of livelihood activities (Albizua *et al.*, 2024), and diversification of activities (DFID, 1999). The strategies implemented yield livelihood outcomes like increase in income and improvement in well-being (DFID, 1999).

Apart from the above strategies, people also depend on their social interactions to determine how they respond to changes (Cetin, 2022; Gamper, 2022). Social theories like the social network theory and social capital theory explains these social dynamics.

2.11.1 Social network theory – this is about social relationships in which people are embedded and the structures these relationships form (Gamper, 2022). This theory helps explain human social organization and how it influences processes such as the flow and dissemination of information within society (Cetin, 2022). These relational connections shape people and the broader social structures they are part of, making it impossible to view individuals in isolation from their networks (Gamper, 2022). These structures play a significant role in shaping individuals' actions (Cetin, 2022; Gamper, 2022).

2.11.2 Social capital theory – this refers to the value and importance of relationships as a resource for social action (Gannon and Roberts, 2020). It encompasses the productive resources embedded in and obtainable from the social network relationships an individual possesses (Leenders, 2014; van Bakel and Horak, 2024). Also, social capital can be regarded as a collective asset, consisting of shared norms, beliefs, values, trust, social relations, networks, and institutions that enable collective action, coordination, and collaboration for individual or mutual benefit (Leenders, 2014; Gannon and Roberts, 2020; van Bakel and Horak, 2024). These resources accrue to the actor, facilitating the achievement of goals that might otherwise be unattainable in its absence (Leenders, 2014). The impact of social capital stems from the information, influence, and solidarity it provides to the actor (van Bakel and Horak, 2024). However,

social capital can also have negative consequences. For example, violent or criminal gangs arising from the strengthening of internal relationships that it creates (Leenders, 2014).

Based on these social theories, it is critical to remember that these dynamics can human perceptions on an issue and how they relate to it. This can have a bearing on the findings of the research.

2.12 Knowledge gap

The literature reviewed provided evidence to show that lithium mining is associated with both negative and positive to the environment and society. With the increase in lithium extraction projects due to the current lithium boom, more and more host communities will continue to be impacted. Considering the lack of scholarly research on the impacts on lithium mining in Zimbabwe, this research study contributes towards addressing this gap

2.13 Chapter summary

This chapter reviewed literature on the global rise in lithium demand and how this have affected the livelihoods of mining communities and the environment. From the reviewed literature, lithium mining affects both the environment and society and the impacts are varied. Literature on how the rise demand for lithium has translated to the current boom in Zimbabwe was also reviewed. From the literature it is clear that this demand for lithium will continue to increase. This increase has seen new mines opening up in Zimbabwe within a space of time. From the impacts noted, it is possible that communities in Zimbabwe will also suffer some if not all of the impacts. Literature on the Sustainable Livelihoods Framework which was used in this research study to establish the impact of the mine on the environment was reviewed. Strategies that are commonly used to cope with negative impacts on livelihoods were also identified as well as the social relationship dynamics that can influence how people respond to change. Lastly, the gap noted from literature after a thorough review of it was highlighted. And this study contributes towards covering this gap.

CHAPTER 3: RESEARCH METHODOLOGY AND STUDY AREA

3.1 Context

This chapter discusses the research methodology that was utilized to determine how mining activities are impacting livelihoods and the environment from the perspective of the community's lived experiences. Based on this objective, a qualitative approach was adopted to explore the phenomenon. Arcturus Mine, one of the new lithium mines in Zimbabwe, was used as a case study to examine the impacts of mining in this lithium boom era, which has seen the fast-tracking of mining projects. To assess the interplay between mining activities and community livelihoods, the Sustainable Livelihoods Framework was employed. Grounded in this framework, semi-structured interviews were conducted with members of the surrounding communities to identify and understand their perceived impacts. Interview responses were analyzed and categorized to identify patterns linked to the framework and research questions. This process was undertaken to determine which livelihood capitals had been affected by the mine.

Beyond changes in livelihoods, this research also sought to determine the environmental impacts arising from mining activities, particularly in relation to water availability. Once again, community perspectives were used to explore this aspect. From literature, environmental degradation arising from mining operations can also affect livelihood activities. As such, this aspect was chosen to determine whether the community had experienced similar challenges. However, the environmental impacts explored were limited to water availability, as literature has highlighted this as a common and major issue in areas where lithium mining takes place. The perceptions of research participants were used to assess this aspect in this research. Accordingly, the same research approach was applied to investigate this issue.

Permission to carry out the study was obtained from the Ministry of State for provincial affairs and devolution as well as the Goromonzi Rural District Council (approvals attached in Appendix II). Also, since this study involved humans, an ethics clearance was obtained from the university before data collection was commenced (certificate number GAES-2024-112). Then to facilitate access to the research site and build trust

with community participants, assistance of an influential and well-respected member of the community was enlisted by the researcher. The role of the assistant was to guide the researcher and act as an intermediary throughout the data collection process. Hence the guide role was accompanying the researcher, introducing her to participants, and assisting her in navigating the area, as the researcher was not very familiar with the research area. The assistant was selected for his familiarity with the research area and their willingness to cooperate with the researcher. Fair compensation was given to the community guide for their time and expertise, in accordance with local norms and standards.

Against this background, this chapter is divided into six sections, detailing how the research was conducted and the rationale behind the selected strategies. First, the study area is described to provide a deeper understanding of the project. Next, the qualitative research approach adopted in this study is explained, followed by a discussion of the chosen research design. The next sections cover the sampling methods used and how the sample size was determined. After that, the data collection methods employed are explained. Finally, the data analysis process engaged in this study is explained.

3.2 Overview of Study Area

As the study focused on livelihood and environmental impacts of Arcadia Lithium mine, on communities surrounding the mine were considered. The mine is immediately surrounded by A1 farms. These are small scall farms were allocated to the holder during the 2000-2002 land reform programme (Njaya, 2014). The farms remain under government administration and tenure, even though they are heavily influenced by a customary system similar to communal areas (Chipenda, 2018). Specifically, communities bordering the mine and those along the route of the mine's activities were visited. These include Murape village, Lawfield farm, Almersfields, Rudolphia, Mapfeni, Gilnockie farm, Madhonga village, Chinyika and ADA farm. The mine claim occupies about 9km^2 (Lycopodium, 2021) which is under a section of Lawfield farm. While most of the communities neighbor the mine, Murape, Madhonga and Chinyika interact with the water abstraction and transportation activities of the mine. Fig 2 below shows the location of the sampled communities in relation to the mine.

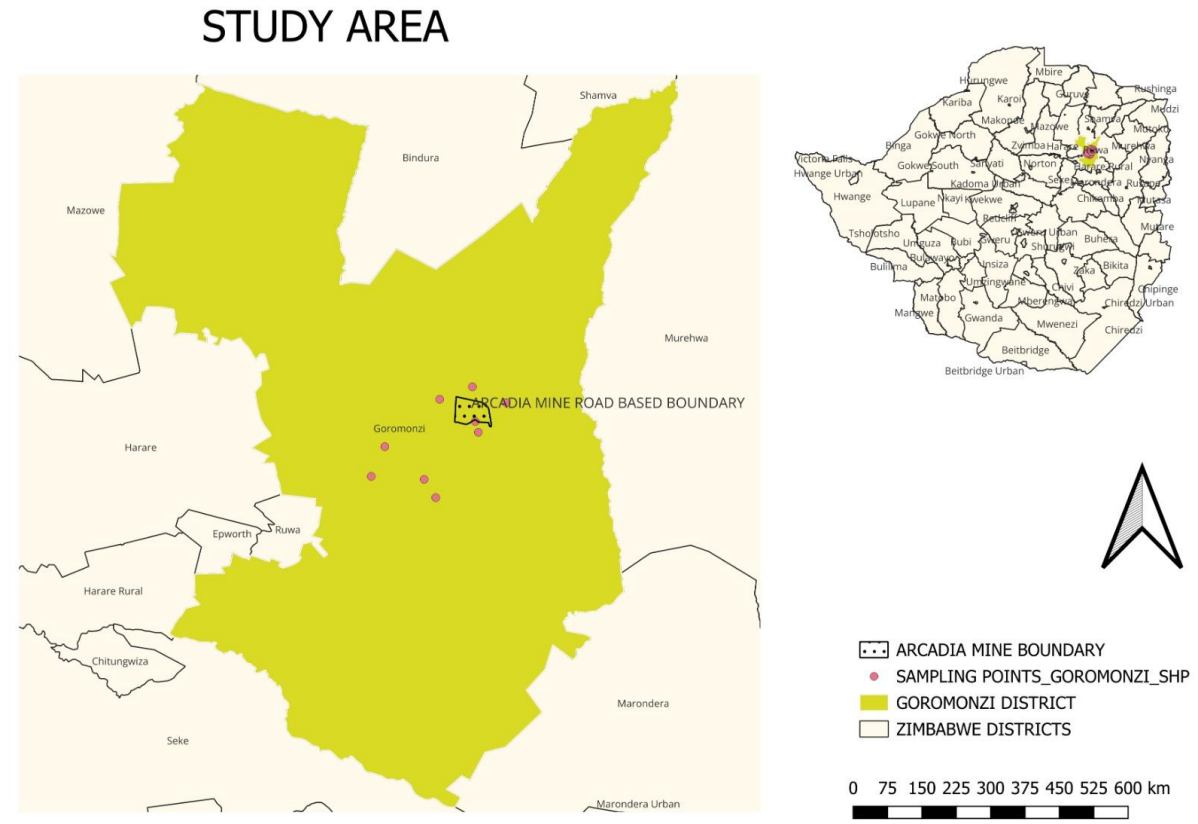


Fig 2: Location of sampling points.

Source: Author

Arcadia mine is located in Mashonaland East province in Zimbabwe, within Goromonzi rural district council (PRL, 2021). It is about 38km east of the capital city, Harare (17º46'26" S 31º24'34" E) and 9 km east of the now nonoperational Arcturus gold mine (Lycopodium, 2021). Due to its proximity to Harare, the mine has access to a source of skilled, semi-skilled and qualified technical labour (Lycopodium, 2021). The Project is close to major highways and railheads, with the Mozambique Beira Port less than 590 km away. The mine site is located on a highland within the Chishawasha uplands range, with an elevation varying between 1 300 m – 1 410 m above mean sea level (Lycopodium, 2021). Fig 3 shows the location of the mine in the country.

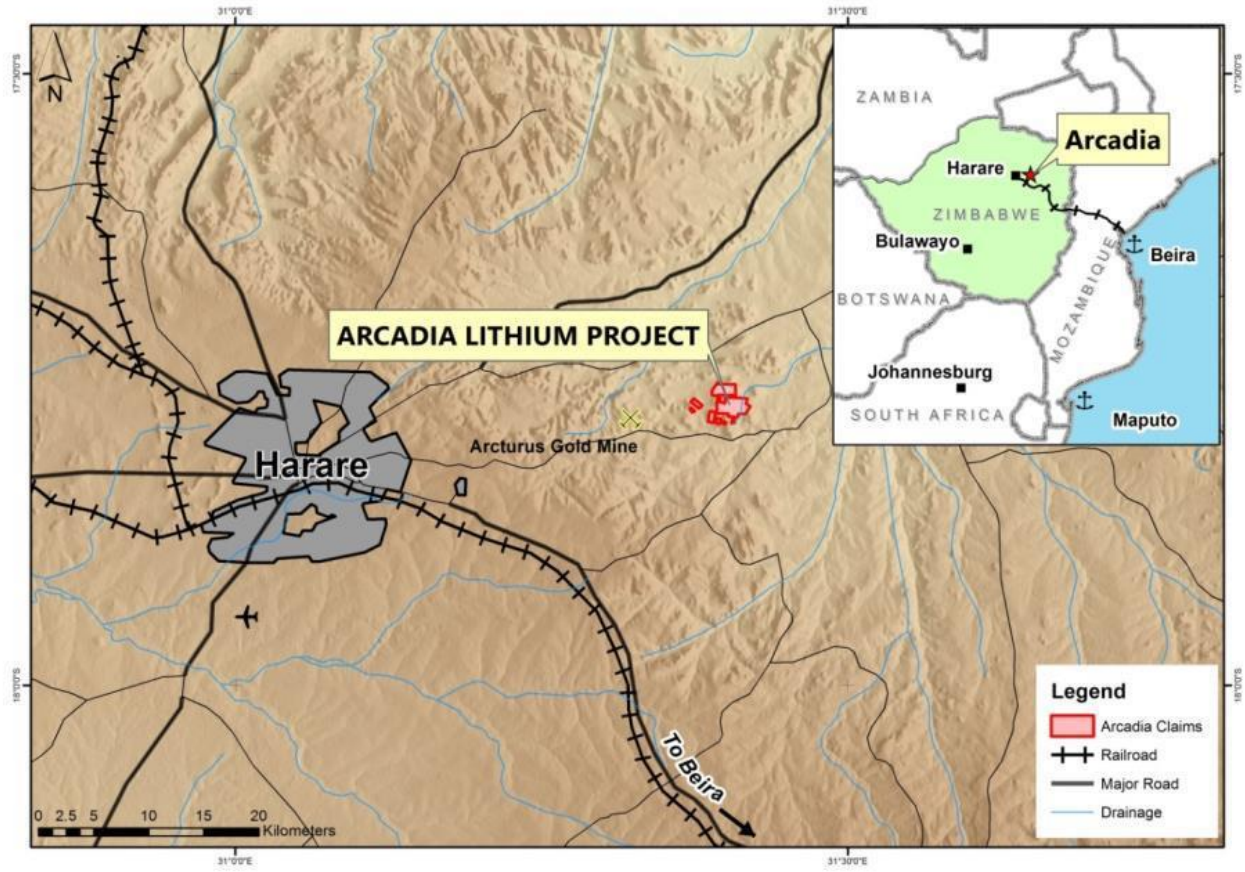


Fig 3: Location of Arcadia Lithium Project

Source: Prospect Resources

3.2.1 Mine history and ownership

The mine was initially owned by Prospect Resources Limited, an Australian company, through its 87% stake in its local subsidiary Prospect Lithium Zimbabwe (Pvt) Ltd (PRL, 2021). Prospect then developed the mine, shipping of its first 25 tonnes lithium concentrate, technical grade from the pilot plant in October 2021 (PRL, 2021). The project was then acquired by, Zhejiang Huayou Cobalt, a Chinese company in 2022 and construction started (HC, 26 May 2023). In May 2023, Huayou announced the commissioning of the lithium mine project and the successful production of its first batch of lithium concentrate (HC, 26 May 2023). This was also reported by Parker (2024), indicating that Arcadia began exporting lithium concentrates in April 2023. Currently, Arcadia lithium mine project is largest processing plant in Zimbabwe, with an annual lithium concentrate output target of 450 000 tonnes (Amaranthcx, 2024). It is also Huayou Cobalt's largest sole investment project in Africa (HC, 2023).

3.2.2 Mine communities

As indicated earlier, Arcadia Lithium mine is located in Lawfield Farm, one of the A1 farms located in Ward 13 of Goromonzi District. In total, Goromonzi has 25 wards (Munyaka *et al*., 2025). Lawfield farm has 26 with plot holders, each holding about 6 hectares arable land. The community has a communal grazing area shared by all plot holders in the area. The farm is headed by a village head. Land tenure in Goromonzi includes communal, freehold, and state ownership, with major uses in large-scale commercial farming, and urban zones (Munyaka *et al*., 2025). Surrounding the mine are households, farmlands and grazing fields all divided into different farming communities. Major livelihoods activities for the community include farming, cattle rearing, gold panning and fishing.

3.2.3 Physical Environment of the area

Goromonzi is in agro-ecological zone natural Region II (Gutsa, 2017; Mutambara *et al*., 2012) a climatically favorable agro-ecological region. It is characterized by hot wet summer season and cold dry winters. It receives good rains of about 700mm per annum on average (Zvigadza *et al*., 2010; Mutambara *et al*., 2012). Temperature ranges around 26-29 degrees Celsius in summer (Mutambara *et al*., 2012). The region's has fertile soils which support diverse agriculture (Munyaka *et al*., 2025). This is also supported by Zvigadza *et al*., (2010) who say the region is also ideal for livestock intensive and crop production.

Flora is characterized by mixed woodland indigenous vegetation typically confined to the less easily cultivated hilly ground (Lycopodium, 2021). Most of the area is sparsely vegetated with shrubs and common tree species are Julbernadia globiflora, Eupaca kirkiana and Parinari curatelifolia (Zvigadza *et al*., 2010). The soils are from the same parent rock however with differing in properties due to different topographical positions they occupy (Zvigadza *et al*. 2010). Different soil types exist in Goromonzi ant they include red clay soils, deep sandy, and sandy loamy, all suited for diverse crops and agricultural activities (Chipenda, 2018). However, most of the areas are covered in fersiallitic, overlying basic greenstone lithologies and mafic intrusive rocks (Lycopodium, 2021). Red clay soils rich in soil nutrients and support a wide range of crops like soyabeans, maize, are found in areas surrounding the mine, while sandy

soils, prone to leaching and erosion, are dominant in communal villages like Murape and Madhongo (Zvigadza *et al*., 2010)

The Arcadia lithium mine project, was chosen as it is one of the new lithium mining projects in Zimbabwe that surfaced as a result of the global lithium boom. Also, currently being the largest producer in the country and it strategic location which makes access to it easy for the researcher, the site was chosen.

3.3 Research Approach

Synder, (2019) identifies qualitative, quantitative, and mixed research as the three main methods available. To achieve the aims of this study, a qualitative research approach was chosen. Qualitative research refers to the type of data generated through the research process, which is usually presented in textual form (Ugwu and Eze, 2023). The information gathered in qualitative research focuses on how something is processed or experienced rather than on precise facts and figures (Squires and Dorsen, 2021; Lim, 2024). The lived experiences of the communities surrounding the mine is what this research was interested in.

This approach was selected because the researcher aligns with the constructivist worldview, a perspective commonly associated with qualitative research (Creswell, 2014). In line with Creswell and Creswell's (2018) analysis of this worldview, this researcher believes that as people seek to understand their world, they develop diverse and multiple meanings of their experiences that are subjective. This perspective necessitates that researchers embrace the complexity of views, relying as much as possible on participants' perceptions of the studied phenomenon (Creswell and Creswell, 2018). Consequently, research questions must be broad, open-ended, and general to allow participants to construct their own understanding of the situation (Nair, 2023). To gain insight into how the community perceives and experiences the impact of the new lithium mine on their livelihoods, it was essential to employ an approach that allowed them to express themselves freely rather than being confined to limited response options in closed-ended questions.

Lim, (2024) simply describe qualitative research as an in-depth examination of research issues. More specifically, Creswell and Creswell (2018) define qualitative

research as an approach used when a researcher seeks to explore and understand how individuals or groups assign meaning to a human or social related problem. That is to say, qualitative approach aids in understanding how individuals or communities interact with social situations, problems, events, or roles (Creswell and Creswell, 2018). Goundar (2012) supports this view, stating that qualitative research seeks to extract meaning, emotions, and descriptions of a situation. Along the same lines, Lim (2024) limits qualitative research to studies that focus on social and cultural phenomena, while Squires and Dorsen, (2021), describe qualitative research as an inductive and exploratory method that investigates how individuals perceive and experience specific situations in their lives.

Unlike quantitative methods, which aim to achieve breadth of understanding, qualitative methods focus on achieving depth of understanding (Palinkas *et al*., 2013). In qualitative research, a population is described without attempting to quantify variables or establish relationships between them (Goundar, 2012). The intent of this approach is to conduct an in-depth exploration of the phenomenon under study (Snyder, H. 2019; Squires and Dorsen, 2021), rather than to represent the study population broadly or provide extensive coverage of the phenomenon (Subedi, 2021). This study sought to understand the lived experiences of the community, without quantifying the perceptions.

Recognising that this approach is used to assess people's knowledge, behaviors, attitudes, and opinions on a given topic, it was deemed suitable for this study. Additionally, qualitative research is often employed when a concept is in its early stages due to a lack of theory or previous research (Mason, 2010). It is also used for finding patterns or fresh views when a topic is new or still being defined (Ugwu and Eze, 2023), or when little is known about a subject (Jeanfreau and Jack, 2010). This approach allows researchers to explore meanings and explanations that may not be easily detected in quantitative research (Lim, 2024). Against this background, coupled with the recent emergence of lithium mining in Zimbabwe as a result of the global lithium boom, an exploratory study was necessary to fully examine this phenomenon. New lithium mines have been rapidly emerging in Zimbabwe (Mkodzongi, 2024), introducing new operating conditions that had not previously existed in the country (ZELA, 2023). The dynamics associated with this fast-tracked lithium mining and its

impact on the livelihoods of nearby communities need to be thoroughly investigated. This understanding is crucial for developing strategies to mitigate potential negative effects on local communities.

According to Lim (2024), the main advantages of qualitative research are its flexibility, focus, and ability to produce findings that readers can easily relate to. This flexibility was capitalized during the research, with the researcher rephrasing questions along the discussion process to ensure responses remain in line with research questions. Additionally, since results are obtained directly from affected people through direct observation and interaction, qualitative research is often completed quickly.

However, Lim (2024), also highlights some limitations. A common issue in qualitative research is the misuse or misunderstanding of its capabilities. Researchers often fall in love with the rich data they collect and mistakenly assume that their findings are generalizable, which is incorrect (Goundar, 2012; Lim, 2024). Because qualitative analysis is subjective and based on a sample, broad generalizability is not possible (Lim, 2024). Furthermore, in reality, qualitative research does not always provide definitive conclusions; rather, it generates sufficient information to form a solid foundation for decision-making (Goundar, 2012; Lim, 2024). This understanding guided the researcher throughout the research process.

3.4 Research design

A single-case study research design was utilized in this study to obtain detailed information on the livelihood changes of households in the Arcturus rural community. Coombs (2022) defines case study research design as a methodological approach for generating a comprehensive understanding of a real-life situation within a bounded system. Expanding on this definition, Creswell and Creswell (2018) describe case studies as a design of inquiry bound by activity and time, enabling researchers to conduct an in-depth investigation of an activity, event, or individuals.

While a case study may include one or multiple cases (Sibbald *et al.,* 2021), this research focused on a single case. In a single-case study, the emphasis is placed on an issue confined to one specific case to illustrate the subject matter (Coombs, 2022).

This study was confined to the examination of the impacts of the Acadia lithium mine to its surrounding communities.

A case study research design was chosen based on Sibbald *et al*., (2021) observation that case study research is widely used in qualitative research to conduct a detailed examination of people's actual experiences. Also, it provides a deep understanding of complex situations or issues by offering insights into new phenomena or contributing additional evidence to existing research knowledge (Goundar, 2012). Additionally, it allows researchers to collect rich, detailed information about an event or activity (Creswell and Creswell, 2018), aligning with this study's objective of analysing the effects of the Arcturus lithium mine on the rural community, the case under investigation.

3.5 Sampling and Sample size determination

3.5.1 Sampling Methods

Various sampling strategies can be used in qualitative research (Yin, 2011; Palinkas *et al*., 2013; Nyimbili and Nyimbili, 2024). For this study, purposive sampling and snowball sampling methods were selected. These are non-probability sampling methods where participants with experience or knowledge relevant to the area of interest are chosen (Palinkas *et al*., 2018). These methods can be used individually or combined in any sequence (Nair, 2023). While some authors categorize sampling strategies as either purposeful or non-purposeful, with snowball sampling considered a type of purposive sampling (Palinkas *et al*., 2013; Chan 2020), others view these methods as distinct (Yin, 2011; Pasikowski, 2023; Nyimbili and Nyimbili, 2024). This inconsistency in classification can create confusion, especially when trying to establish a common language in qualitative research sampling discussions (Gentles *et al*., 2015). Following Gentles *et al*., (2015) who recommends researchers to define what purposive sampling means in their specific context, this research considered both as unrelated methods.

Purposive sampling is extensively used in qualitative research to identify and select information-rich participants who are most likely to provide valuable insights for understanding the research phenomenon (Palinkas *et al*., 2013; Nyimbili and Nyimbili, 2024). On the other hand, snowball sampling involves participants recommending

other individuals who may be relevant for inclusion in the study (Chan, 2020; Nyimbili and Nyimbili 2024). Nyimbili and Nyimbili (2024) define snowball sampling as a technique in which an initial participant identified and relevant to the study, refers the researcher to another participant with similar characteristics until the desired sample size is achieved. While, Padgett, (2013) mentions that the words participants and informants are used to refer to samples rather than respondents in to qualitative research, in this report, all the three are used to refer to the sample.

Guided by these authors, participants for this study were purposefully selected based on the relevance of the information they were assumed to have and the richness of their experiences in relation to livelihood changes following the onset of the mine. As such, households residing in communities surrounding the mine were selected. Residents living closest to the mine were prioritized, as they were believed to be most affected by the mine's activities, hence rich in relevant information. Only participants above 18 years of age were included in the study. In households where the head of the family was unavailable, the most senior member, provided they were 18 or older, was selected. The focus on household heads was based on the assumption that they are responsible for family welfare and would be most knowledgeable about livelihood changes due to the mine's activities. Additionally, priority was given to permanent residents of the communities or those who had experienced life before and after the onset from the mine. These were expected to have more comprehensive knowledge of the situation than visitors. Key informants which included village heads and regulatory authorities who work in and with local communities were also selected.

Following this purposeful selection, snowball sampling was employed to follow up on referrals made by participants. In each village sampled, the first point of contact was the village head, followed by referrals from the village head and other households surrounding the mine. Referrals from these were also included in the research sample. As the researcher believed that she was conducting a sensitive study which might be perceived by the research participants as being politically inclined, snowball technique was also chosen to complement purposeful sampling. According to Jeanfreau and Jack, (2010), this sampling method helps in research participants gaining trust with the researcher and the study.

Apart from this, Palinkas *et al*., (2013) mentions that there are variations that exist within a population from which purposeful sample is to be drawn and these are often unknown at the onset of a study. This makes sampling information-rich participants a challenge. On the other hand, Chan, 2020 says snowball sampling can introduce bias because participants tend to refer others who are similar to themselves, potentially leading to correlated samples. Therefore, to mitigate this bias, both purposive and snowball sampling were combined to ensure a balanced and diverse sample. Over and above this, diverse participants who capture all the dimensions related to the study area and within the boundary of the study population were selected as advised by Ritchie *et al*., (2013). Access to the population that possess specific characteristics relevant to the study and availability of resources were also taken into consideration as guided by Nair, (2023).

3.5.2 Sample size determination

Sample size can refer to the number of interviews to be conducted or relate to number of participants included in the study (Gentles *et al*., 2015). In this research, it is considered in terms of the number of participants. Determination of sample size is one of the major concerns by researchers carrying out qualitative research as the issue of adequate sample size is debatable (Subedi, 2021). There are no widely accepted guidelines or principles for determining the number of participants in qualitative studies (Hennink and Kaiser, 2022; Mocănașu, 2020). Several factors influence the determination of sample size, including the purpose and nature of the study, the research questions (Mocănașu, 2020), the nature and scope of the study (Cena *et al*., 2024), data type and collection methods (Mocănașu, 2020), data saturation (Gentles *et al*., 2015; Subedi, 2021; Hennink and Kaiser, 2022), budget and timeline (Tracy, 2020), analytical strategy and the availability of participants (Mocănașu, 2020).

In this research, data saturation was used to determine sample size. This was chosen due to its wide acceptability as a guiding principle to indicate when sufficient data has been collected (Gentles *et al*., 2015; Hennink and Kaiser, 2022). Also, this concept of saturation allows the researcher to adjust the sample size as needed, increasing or decreasing the number of participants from initial plan, depending on the study's needs and the collection of sufficient data (Subedi, 2021). That is, the researcher can start with a specific sample size and modify it along the process (Nair, 2023). In view of

this, the researcher started with an initial plan to interview 25 participants and four more were added as the research progressed. This flexibility was another factor that was considered in this research. Saturation occurs when additional data collection contributes little or nothing new to the study, and participants begin repeating information they have already provided (Hennink and Kaiser, 2022; Mocănașu, 2020).

Since qualitative methods do not aim to generalize findings to a larger population, but gain an in-depth understanding of the complexity, depth, variations, and context surrounding a particular situation, small sample sizes are best suited for such research (Lim., 2024; Subedi, 2021). Supporting this view, Creswell and Creswell (2018) state that qualitative research is characterized by a limited number of participants, with no fixed rule regarding the exact number of participants or sites to include. This research sampled 29 participants so as to allow for in-depth discussions which bring about the perceptions of the community.

Although determining the optimal sample size in qualitative research is challenging (Mason, 2010; Barkhuizen, 2014) found that twenty to thirty participants are the most common sample sizes, followed by ten, twenty-five and forty. For case studies, recommended sample sizes range from one to one hundred and thirty-five cases (Barkhuizen, 2014), four to ten cases (Gentles *et al*., 2015), one to ninety-five cases (Mason, 2010), and thirty to fifty cases (Squires and Dorsen, 2021). Yin (2011) suggests twenty-five to fifty cases specifically for a single case study and says actual figure depend on the complexity of the topic and the required depth of data collection.

In this study, the initial plan was to sample 25 participants, based on their availability and the goal to reach data saturation. This number was acceptable to the researcher, as it fell within the range proposed by several authors. However, the researcher remained flexible and adjusted the sample size based on the saturation concept. Data collection and analysis were conducted daily to identify any emerging gaps or areas of priority for the next data collection session. Data saturation was reached after 29 participants, at which point data collection was concluded.

The researcher chose this approach due to its flexibility, as it does not require a predetermined number of participants. The emphasis is on achieving the research

objective rather than representing a large sample. Therefore, the researcher's primary goal was to thoroughly explore the phenomenon rather than generalize the findings.

3.6 Data Collection

For this research, data collection was conducted primarily through semi-structured interviews. Additionally, personal observations and a review of publicly available secondary documents were utilized as data sources. These included reports from the Ministry of Mines, newspaper articles, and Arcadia lithium mine company websites. This approach facilitated a comprehensive understanding of the socio-economic changes affecting household livelihoods (Creswell and Creswell, 2018).

According to Ugwu and Eze, (2023) qualitative data sources include observations, participant observations, interviews, questionnaires, documents and texts. Further to this, Myers (2013), had the researcher's impressions and reactions as another source. Semi-structured interviews were chosen as the main data collection method for this research, as several authors identify them as the most widely used and relevant method for qualitative data collection (Creswell and Creswell, 2018; Ruslin *et.al*., 2021; Nair, 2023). Semi-structured interviews allow for exploratory research, enabling researchers to obtain in-depth information while maintaining focus on the study (Ruslin *et.al*., 2021). Nair (2023) concurs, stating that these interviews are particularly useful when the research objective is to understand and interpret individuals' experiences concerning a specific issue.

In this research, the interviews were used with an aim to understand changes in livelihoods and the environment from the research participants' point of view. In their report, Elhami and Khoshnevisan, 2022 highlights that interviews attempt to uncover participants' meanings of their experiences and reveal their lived world which aligned well with this research's aim. Semi-structured interviews employ predetermined open-ended questions, allowing participants to express themselves freely (Nair, 2023). Arksey and Knight (1999) argue that open-ended questions provide a broader scope for data collection, surpassing the researcher's preconceived notions of how things are likely to be. Interviews can be conducted individually or in groups, face-to-face, via

telephone, or through online platforms (Ugwu and Eze, (2023). Semi-structured interviews are generally informal, following a conversational style (Ruslin *et.al.,* 2021).

For this research, open-ended questions were carefully prepared in advance to explore the research questions (Appendix III). These questions served as a guide during the interviews. The semi-structured interviews could also be thematic or topic-centered, allowing the researcher to cover specific themes or issues during discussions (Ruslin *et.al.,* 2021). In this context, the questions used in this research were designed to gather information for analysing livelihoods, guided by both the sustainable livelihoods framework and the research questions.

The semi-structured interviews involved community members and key informants, including EMA regulatory authorities, police officers, and village heads. Interviews were conducted face-to-face, except for EMA regulatory authorities who were interviewed telephonically due to their unavailability in offices during site visits. A total of 29 participants were interviewed. These participants were drawn from nine communities/villages noted earlier (Fig 3).

Among the participants, 22 were community households, three were regulatory authorities, and four were village heads. Interviews were conducted at locations where participants were found and where they felt most comfortable. In most cases, this was at their homesteads, with one group interviewed in their field. Multiple villages surrounding the mine in different directions, were interviewed to provide diverse perspectives on lithium mining impacts and offering a holistic view of their magnitude and breadth. This diversity ensured rich, validated data reflecting the community's experiences.

Research indicates that people respond differently to the situations they face, and group dynamics can also influence these responses (Creswell and Creswell, 2018). Guided by this perspective, group interviews were included in this research to capture diverse viewpoints. Observing information richness, both individual and group interviews were conducted, with the largest group comprising five community members who were found working in their field. The duration of these interviews ranged from 45 minutes to 1 hour and 52 minutes, with the longest being the group

interview conducted in the field. Goundar (2012) highlights that such semi-structured interviews tend to be lengthy, as they allow the researcher to elicit honest, straightforward, and highly complex responses, leading to rich and in-depth data collection. With this in mind, the researcher approached data collection well-prepared and without rushing the process.

Both English and Shona (the native language) were used in the interviews, allowing participants to express themselves comfortably. During transcription, responses were translated into English. Interview responses were primarily jotted down, but some interviews were recorded with participants' consent to ensure all information was captured accurately. The recorded data served as a memory aid during transcription. Recording interviews aligns with Nair's (2023) view that interviews are often recorded with the interviewees' permission.

Probing and follow-up questions were asked where necessary, as effective interviews require a balance between main questions, follow-ups, and probes (Ruslin *et.al*., 2021).

Over and above, the semi-structured interview method was chosen due to its flexibility and relevance to this research approach. It allows researchers to ask new questions in response to participants' answers while maintaining focus (Ruslin *et.al*., 2021). They also grant researchers control over questioning and enable follow-ups (Nair, 2023). Additionally, semi-structured interviews facilitate deeper insights that structured interviews may not capture (Goundar 2012; Ruslin *et.al*., 2021). However, some participants may not be articulate, and the researcher's presence may introduce bias (Creswell and Creswell, 2018). To mitigate these challenges, local language use, referral-based sampling, and group interviews were incorporated to foster participant confidence and facilitate calm, open responses.

As advised by Ruslin *et.al*., (2021) who said while conducting interviews, strong interviewing skills are essential to help the researcher organize questions, determine how to ask them, identify key points for probing and follow-up and effectively interpret both verbal and non-verbal cues. These skills were carefully observed during the

interview sessions to ensure the collection of relevant information that directly addressed the research questions.

Additionally, care was taken to ensure the interviewer did not dominate the conversation, allowing participants to express themselves freely and without interruption. The questionnaire guide was consistently referred to, ensuring the researcher remained focused and avoided leading the participants. Encouraging the participants both verbally and non-verbally, such as through nodding and smiling was also employed to ease tension and foster a comfortable interview environment (Ruslin *et.al*., 2021).

Field notes, which capture non-verbal cues and environmental observations, can enhance interview data and provide context for analysis, improving study quality (Nair, 2023). However, simultaneously conducting interviews and taking detailed field notes is challenging (Nair, 2023). In this study, environmental observations and voice tones were noted but captured to a limited extent due to the difficulty of balancing note-taking with active engagement in interviews.

3.7 Data Analysis

This is a process used by researchers for making sense of large text data (Creswell, 2014; Lim, 2024) so that it can be presented to readers in a systematic manner (Ruslin *et.al.,* 2021). To achieve this, collected data must be transcribed, analysed and interpreted (Nair, 2023). This analysis identifies patterns, themes, or distinctive features within text data (Sterba *et al*., 2014; Lim, 2024). Several analysis methods can be used which include thematic, content, discourse, narrative, and grounded theory (Archer, 2018; Hameed, 2024). The specific approach taken depends on the research question (Ruslin *et al*., 2021; Lim, 2024), aims, objectives and time constraints (Creswell, 2014; Archer, 2018). Thematic was chosen for this research.

Data analysis also relies on human reasoning, and humans seek logical reasoning (Archer, 2018). This brings about the aspects of inductive, deductive, and abductive (a combination of both) approaches to qualitative data analysis (Archer, 2018; Nair, 2023). Inductive approach which involves deriving concepts or themes directly from raw data, (Archer, 2018) was chosen for this study.

According to Sterba *et al*., (2014), thematic analysis is used to analyse perspectives, views, and opinions and aims to identify patterns of meaning in data. In thematic analysis, data is broken down into its smallest constituent parts (codes), and then these codes are restructured and grouped into categories known as themes (Archer, 2018; Lim, 2024). This type of analysis was chosen as the research questions for this study were centred on determining livelihood activities based on a predetermined framework. Codes and themes were drawn from the sustainable livelihoods framework and research questions. These codes were used to organize text, and the resulting themes in line with the deductive approach. This was primarily to enable the researcher to easily identify livelihood activities that had been affected within limited time constraints. Additionally, the research sought to analyse community views, both of which are aspects that can be examined using thematic analysis.

While qualitative data can be analysed using computer software or manually (Jeanfreau and Jack, 2010; Archer, 2018). In this research, manual analysis was conducted since the researcher had already identified the categories for comparison and alignment based on the Sustainable Livelihoods framework and research questions. In this manual analysis, the researcher had to read through each line of text and group the data accordingly. However, this process can be slow and labor-intensive (Creswell and Creswell, 2018). The following six stages of qualitative data analysis outlined by Creswell (2013) were used in this research. analysing

Step 1: Organize and Prepare the Data

Once data is collected, it must be transcribed. In this research, only verbal responses were transcribed; however, key tonal elements were highlighted during the presentation of results. This choice partly aligned with Nair, (2023) who indicated that during transcription, researchers may choose to transcribe only verbal responses or include additional details such as tone of speech, emphasis on certain words, and facial expressions. Field notes were also typed. As most of the interviews were conducted in the local language, Shona, this process also involved translating the data into English. The researcher also cleaned and organized raw data into a format that was easy to work with. Care was taken to ensure original information was preserved as much as possible while avoiding distortion.

Step 2: Familiarize yourself with the Text

To enable the researcher to gain familiarity and a general understanding of the text, in this research, the data was read several times. Apart from enabling the researcher to gain a general sense of the data and reflect on its overall meaning (Lim, 2024), this also helps the researcher quickly locate relevant material (Ruslin *et.al.,* 2021). By reading the text several times it also became easier for the researcher to find related text during coding.

Step 3: Data Coding

Coding in which data is organised chunks or segments of related text based on their relevance to research questions (Archer, 2018; Lim, 2024), allows for the interpretation of large text segments and parts of information in new ways (Belotto, 2018). Furthermore, it offers a means of purposefully handling, locating, identifying, winnowing, sorting, and querying data (Archer, 2018). To make coding easier, Belotto (2018) advises use of the structural coding method, where passages are labelled with terms related to the research questions. Based on this advice, in this research, codes were derived from keywords mentioned in the research questions as well as the 5 capitals under the Sustainable Livelihoods Framework. Once the codes were created, sections of text relating to these words were selected and highlighted.

This was applied to other sections of text relating to the same idea, again as guided by Archer, (2018). As guided by Belotto (2018), sections of text were highlighted using different colours to represent different codes, with the same colour used for texts related to the same idea. The highlighting method was chosen for ease of locating related text, and also considering that it is a well-established technique for outlining sections of text (Belotto, 2018). Given the richness of interview text, not all collected information can be used. Careful winnowing of data was performed to retain only information relevant to the research questions while avoiding the loss of valuable insights.

Step 4: Theme Development

According to Squires and Dorsen, (2021), three to five themes normally emerge from most qualitative studies even though can occur with large sample sizes or highly

heterogenous samples. On the other hand, Creswell, (2013) recommends generation of about five to seven themes for a research study once the coding process has been completed. A theme can be defined as the grouping of codes into clusters that share similar characteristics that represent a pattern in the text (Archer, 2018). Themes are derived at by systematically categorizing data according to properties, such as research questions that match the text being categorized and related interview questions (Ruslin *et.al*., 2021). The goal is to detect recurring themes and classify data accordingly (Lim, 2024). However, in this study, themes were already known from the framework used and research questions. Hence, the researcher did not wait for data collection to be completed before starting theme development.

Data was categorized according to themes derived from the Sustainable Livelihoods Framework and research questions. Throughout the clustering process, each new piece of data was compared against previously grouped information and existing literature and the framework guidelines. This was done to confirm interpretations and ensure appropriate classification as guided by Jeanfreau and Jack, (2010). Analysis of interview data and the write-up of findings began while data collection was still ongoing, rather than waiting until all interviews were completed. This aligns with Creswell (2013), who contends that in qualitative research, data collection and analysis must be a simultaneous process. This approach allowed the researcher to determine when to stop data collection upon reaching data saturation, when no new information emerged. These themes are indicated in the results section as advised by Creswell, (2018) who said usually, these themes appear as major findings in qualitative studies and are often used to create headings in the results section of a study.

Step 5: Representing Themes in the Qualitative Narrative

After categorizing the data, results are summarized, and patterns are used to develop conclusions (Ruslin *et.al.,* 2021). Ultimately, the final interpretation or theory emerges from the data (Lim, 2024). While quantification is possible in summarizing, clear-cut data categories must be maintained (Ruslin *et.al.,* 2021). In describing themes, the most popular approach is to use a narrative passage to convey the findings of the analysis. This might be a detailed discussion of multiple themes or an interconnected theme-based discussion (Creswell, 2013). Themes should reflect multiple

perspectives from participants and be supported by diverse quotes and specific evidence (Creswell, 2013).

In this study, summaries were based on the framework and research questions, and themes were developed to ascribe meaning. Themes were described both individually as well as how they affected each other. Quotes from participants' responses were used to support findings in each category. Results were presented in a way that showcased the views of the community under each theme.

Step 6: Data Interpretation and Deriving Meaning

This step involves highlighting lessons learned. These lessons could be derived by comparing the research findings with information gathered from literature or theories (Creswell, 2013; Lim, 2024). In this way, the researcher assesses whether the study's findings confirm or diverge from existing knowledge. Results from this study were compared with literature and presented in the discussion section.

Apart from the six steps above described above, there are other important issues to note in qualitative data analysis which may introduce bias. These include issues of the interviewees' judgments hidden from the researcher and researcher's preconceptions which they come with most of the time (Ruslin *et.al*., 2021). To manage bias arising from these in this research, questions were asked in multiple ways, and responses were cross-checked for consistency.

Maintaining rigor is another critical issue in qualitative data analysis and this can be achieved by ensuring that research participants' experiences are accurately represented (Squires and Dorsen, 2021). Also, accurate interpretation of participants' responses is necessary for establishing trustworthiness (Lim, 2024). Throughout this study, accuracy in both representation and interpretation of data was carefully observed.

CHAPTER 4: RESULTS

4.1 Introduction

In this chapter, findings on the changes in livelihoods of the communities surrounding the mine and the availability of water following the onset of lithium mining operations are presented. These findings are categorized into themes derived from the research questions. The themes include: the socio-economic and environmental impacts of lithium mining activities on livelihood patterns and water availability; the perceptions and attitudes of the Arcturus community towards mining operations; the coping strategies adopted by the Arcturus rural community to address these impacts; and finally, a framework for potential mitigation strategies.

Before analysing the themed data, an assessment of the research respondents' backgrounds and their dominant livelihood activities was conducted. The findings from this assessment are presented below.

4.2 Background of respondents

A total of 29 participants were interviewed for this study, including seven key informants and 22 community members. Over 90% of the community respondents indicated that they reside permanently within the sampled communities. All respondents confirmed that they had been living in the community before the commencement of lithium mining operations.

Figure 4 below illustrates the distances at which research participants reside in relation to the location of the mine. A range of distances was selected to analyse the variability and magnitude of the mine's impacts on surrounding communities.

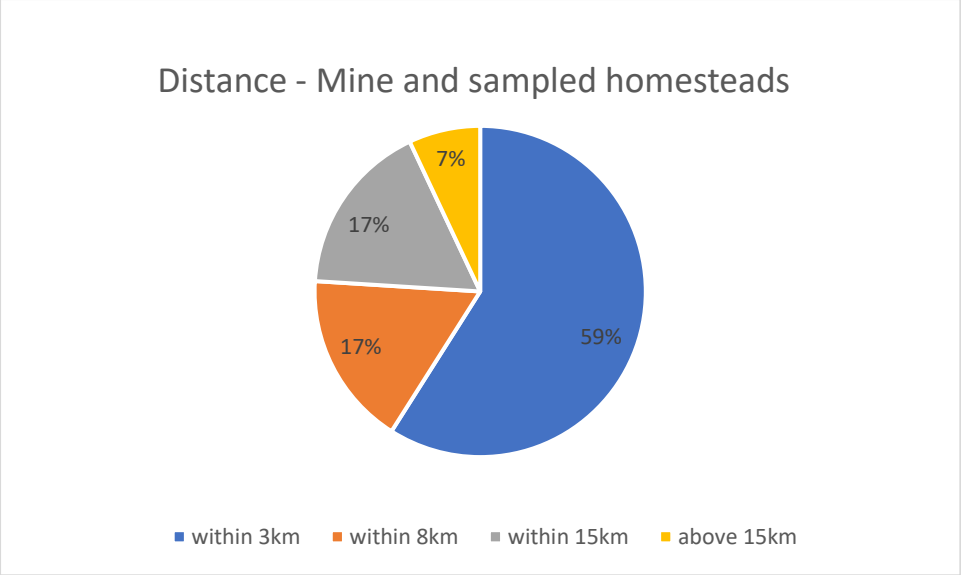


Fig 4: Distance between mine and sampled homesteads

In terms of gender distribution, 18 of the respondents were male, while 11 were female, as shown in Figure 5 below. This disparity may be attributed to the fact that the mine is immediately surrounded by A1 farms, which are predominantly male-dominated, as farming is labor-intensive.

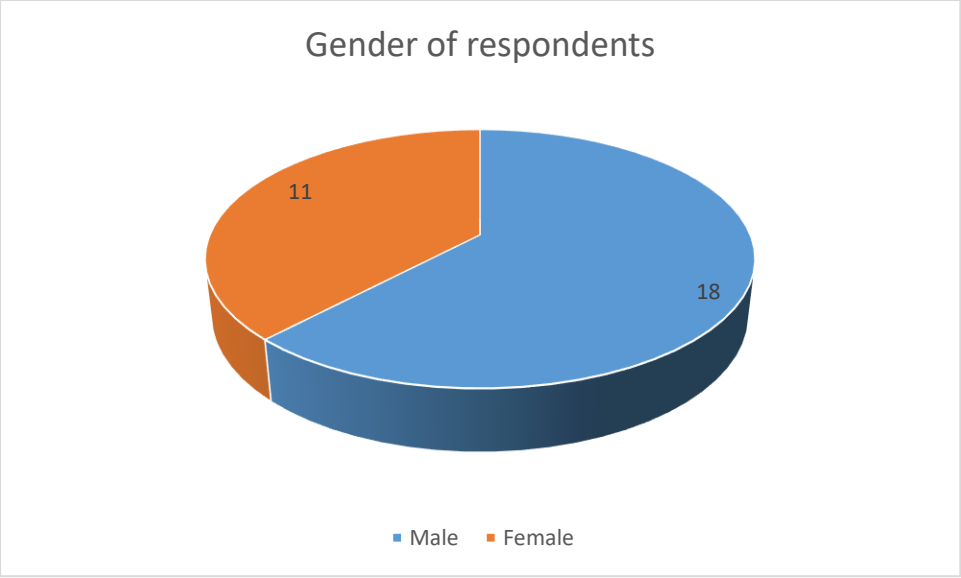


Fig 5: Gender distribution of participants

The dominant age groups among the respondents were the 55–64 and 45–54 age categories, which collectively accounted for over 50% of the participants. Specifically, the 55–64 age group made up 34% of the respondents, while the 45–54 age group contributed 21%. This demographic trend may be attributed to the fact that A1 farms

were primarily allocated to war veterans during the 2000 land distribution exercise, resulting in an older generation being more prevalent among the research participants.

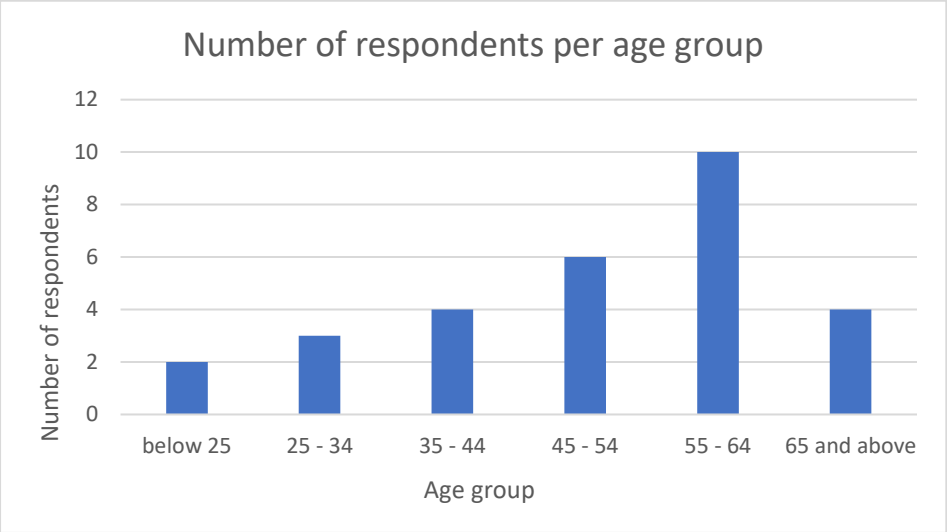


Fig 6: Age of respondents

4.3 Community livelihoods

Households in the studied communities primarily engage in farming activities, while younger generations tend to pursue gold panning or eventually migrate elsewhere. Village heads interviewed indicated that farming was the dominant livelihood strategy in areas immediately surrounding the mine. However, communities located farther from the mine (8 km or more) rely on community irrigation projects as their main source of livelihood. Their farming activities include crop cultivation, animal rearing, and horticulture, either in gardens or through irrigation schemes. Crop farming is seasonal and dependent on rainfall.

Farmers operating under the A1 farming model sell their produce to the Grain Marketing Board (GMB), generating income from their agricultural output.

Table 2: Community livelihood activities and impacts from the mine

Village/area	Livelihood activity	Main impacts from the mine
Lawfield section	- Farming under A1 scheme - Horticulture	- Displacement due to mining activities - Relocation of graveyards - Water pollution from mining operations

	- Cattle rearing - Fishing - Working at the mine	- Increased distance to schools and neighbouring communities due to mine fencing
Almersfield section	- Farming under A1 scheme - Horticulture - Cattle rearing	- Air pollution from mine fumes - Vibrations affecting structures - Lack of employment opportunities
Murape village	- Subsistence farming -Horticulture under irrigation - Rearing of cattle and goats	- Dust pollution from moving trucks - Lack of employment opportunities
Madhonga Village	- Subsistence farming - Cattle rearing - Horticulture	- Dust pollution from moving trucks - Lack of employment opportunities
Ada farm	- Formal employment as farm labourers	- Dust pollution from moving trucks - Lack of job opportunities for younger generations
Mapfeni	- Subsistence farming - Cattle rearing - Horticulture - Fishing	- Drying up of local water sources - Lack of employment opportunities
Chinyika	- Subsistence farming - Cattle rearing - Horticulture under irrigation	- Drying up of local water sources - Lack of employment opportunities
Rudolphia section	- Farming under A1 scheme - Horticulture - Cattle rearing	- Air pollution from mine fumes - Lack of employment opportunities
Gilnockie farm	- Subsistence farming - Cattle rearing - Horticulture - Fishing	- Drying up of local water sources - Lack of employment opportunities

A summary of the livelihood activities pursued by all respondents is presented below.

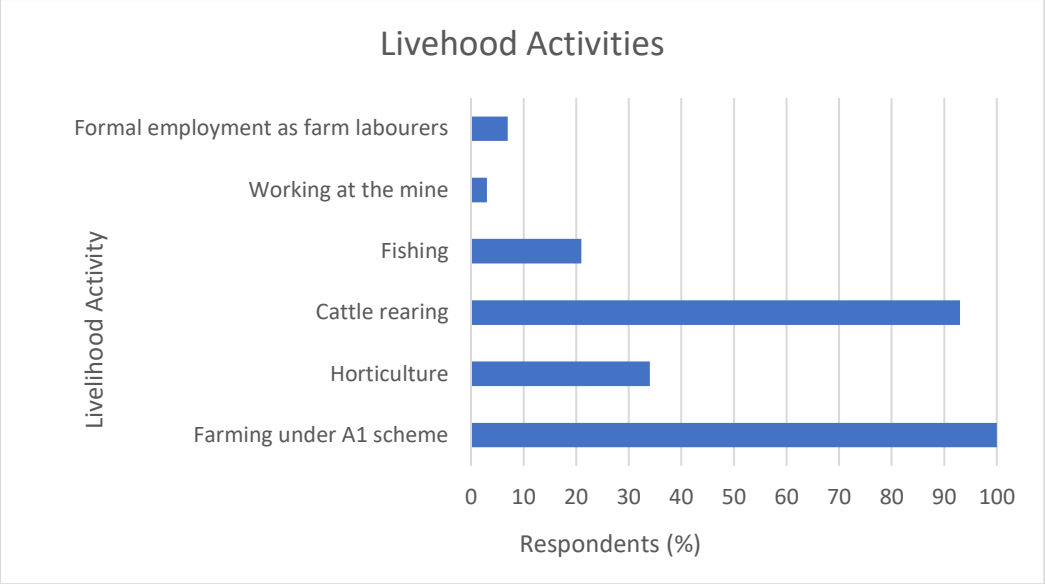


Fig 7: Livelihood Activities

Findings revealed that all respondents (100%) living in communities surrounding the mine rely on rain-fed subsistence farming, primarily cultivating maize for both consumption and sale. Emphasizing this point, one key informant from the Lawfield section said

"We all do farming of maize and beans which we sell to GMB. We also keep cattle for draught power and do fishing for subsistence only. Our dam does not have a lot of fish to allow us to catch for selling fish. During the dry season, we plant horticulture products using irrigation and sell our products at Mbare vegetable market in Harare"

In villages located further from the mine, respondents indicated that their primary sources of income were gold panning and horticulture. One community respondent stated:

"We have since stopped hoping to get any job from the mine. Our source of income is mainly from gold panning and Chinyika irrigation where we do horticulture".

4.4 Socio-economic and environmental impacts of the mine on community livelihood patterns and water availability

As highlighted earlier, the Sustainable Livelihoods Framework (SLF) was used to structure the analysis of how livelihoods have been affected in this research. To assess changes in livelihoods due to the mine's impacts, participants' responses were

categorized into the five classes of capital under the framework. The impact on water availability is discussed under natural capital.

An analysis of responses from the entire study area indicates that only a few respondents had benefited in some way from lithium mining. The positive impacts, sporadically mentioned by respondents per category, included two who had benefited from job opportunities at the mine, growth in small-scale businesses in terms of a food stall at the mine entrance, compensation for the three displaced households and lost crops, a one-time provision of food hampers to surrounding communities, and school fee assistance for children in need. One resident from Almer indicated that less than 40 primary school children had benefited from the school fees initiative. Despite of this, no respondent had benefited in more than two of these categories.

Despite the positive impacts noted above, none of the respondents was overally happy with the mine. All respondents indicated that the establishment of the lithium mine undesirably affected their livelihood. Badly affected livelihoods noted by the respondents include displacement from their homes; loss of crops and farmland; loss of social networking systems, increase in dust related illnesses; reduced access to grazing pastures; loss of fishing grounds; reduced output from irrigation farms, lack of consideration of locals on job opportunities. These are explained below under the different capital classes.

4.4.1 Financial Capital

Of the 29 respondents, only one indicated that they are employed by the mine. The rest stated that neither they nor any member of their household had secured employment at the mine. Community respondent 1 said

> "*The mine hires on short-term contract. When they first arrived, they promised to recruit from the community which they did during those days. However, they started hiring from outside without renewing contracts for the locals. Now you hardly see any local there. All the buses you see coming from the mine are heading to Ruwa and Harare (cities outside Goromonzi) with employees and none is going to any surrounding local communities*".

This sentiment was echoed by one of the group participants of community members, who stated

> "*Jobs are being given to people outside our community. Locals are no longer being considered*".

This indicates that the financial impact of the mine on the broader community is minimal. However, a couple of local women were observed selling cooked food outside the mine premises. Discussions with these women, who identified as residents of the local community, revealed that they were benefiting from the mine's presence. They stated that their food stalls provided them with a livelihood, as mine workers and job seekers regularly purchased meals from them. The women further indicated that the income from their businesses allowed them to send their children to school.

4.4.2 Social Capital

Socially, the communities reported a negative impact on their social structures and relationships due to the fencing off of the mine. This concern was raised during both one-on-one interviews and group discussions, particularly by respondents from the Lawfield, Rudolphia and Almersfield sections. The communities expressed frustration that the fence erected around the mine had blocked footpaths traditionally used for visiting neighbours, increasing the distance they now have to walk compared to before the mine's establishment.

Community resident 2 from Lawfield shared:

> "*That fence you see around the mine, it's stretches very wide. The footpaths we used to take to Almersfield are now enclosed inside the mine by that fence. Going there has become a challenge because it is now very far. If our tractor breaks down, we cannot go there to borrow one, it's too far and time-consuming. Sharing ideas has also become difficult. If you don't have airtime to call, you miss out on a lot of things. The fencing also closed off the road to Vhuta Primary School. Now our children have to take a much longer route, undoing the convenience we had when we built this new school. Some parents have even transferred their children back to their previous schools because Vhuta has become too far. We have been taken backward, and we are not happy at all*."

Another significant social issue that emerged was the relocation of the community graveyard. The mine took over land previously used for burials by the community, a matter that was unanimously lamented by residents from Lawfield, where the mine is situated. Residents expressed deep concern over the emotional distress this would cause, reopening fresh wounds of loss. They also highlighted their frustration that no compensation would be provided to affected families, as the mine claimed the issue had already been settled with the chief. Despite their strong objections, they felt powerless to challenge the decision.

A broader area of disgruntlement voiced by all respondents from communities immediately surrounding the mine was the lack of consultation on decisions affecting their livelihoods. Field responded one, a community resident of Lawfield expressed his frustration saying,

> "*Sometimes we are called for meetings whenever the mine is about to do something significant to our well-being, meetings that we believe should strengthen our relationship with them. But in most cases, we leave more disgruntled than before. During these meetings, we are merely informed about the mine's plans and are not given a chance to express our views or concerns. Recently, we were invited to one such meeting, where we received small Christmas hampers and empty 1000L water containers, the first time we ever got anything from the mine. In that meeting, we were not consulted but were simply told that the mine was going to construct a processing plant and that some households would be affected. Within a few days, we saw graders clearing maize fields on farms near the mine. The maize owners were not even given time to harvest their crops. As we speak, no one knows what is happening there or the full extent of the clearing. We are deeply concerned and not happy at all*."

Residents from the Almersfield section raised specific concerns regarding the impacts of blasting at the mine. They reported that frequent blasting was compromising the structural integrity of their homes and polluting the air. Air pollution was also raised by Ruldophia residents. According to one of village heads, many households had already observed cracks forming on the walls of their buildings. This concern was echoed by an official from the Environmental Management Agency (EMA), who confirmed that

complaints about structural damage had been received from the community. In response, the regulatory authority had issued a notice instructing the mine to assess the extent of the damage and develop a mitigation plan.

Describing the severity of the pollution, Almersfiled community respondent one stated:

"*Whenever they blast, the smoke from the blast turns the whole area white, such that we cannot see each other. All the air travels in the direction of our households and the school. The fumes are overwhelming, we can't see each other properly because of the dust and smoke. Our children at the school are inhaling these fumes every time, and we don't even know what will happen to their health in the long run*."

Speaking to the cloud of fumes that comes after a blast, the picture below was taken from an article available on the previous company's website. It shows the fumes before dispersion to surrounding communities.



Fig 8: Fumes from the blasting.

Source: Prospect Resources

Conflicts over resources also emerged as a significant issue due to lithium mining. Resident two from Lawfield community recounted a particular incident:

"*They wanted to take water from our dam, and we fought with them, even the police got involved. Now they are taking water from Nero and Chinyika*."

This highlights the growing tension between the mining company and local communities over access to vital water resources.

4.4.3 Human Capital

A positive impact was observed in this area. Respondents living closest to the mine acknowledged the mine's contribution to local education through the construction of additional classroom blocks and teacher housing. Residents of Almersfield section also noted that the mine was assisting underprivileged children by covering their school fees.

Almersfield community respondents two stated:

> "*When they came, we were building our primary school. They added more blocks and houses for teachers. They have also been helping with school fees for the less privileged students who are struggling*."

This support was seen as beneficial to the livelihoods of affected families, as it allowed them to allocate their financial resources to other necessities such as food. However, the Lawfield community expressed concerns that the fencing off of the mine premises had diminished this benefit, as the increased travel distance to school had become a challenge. Beyond these contributions, no further assistance for community skills development was noted.

4.4.4 Natural Capital

While the fencing of the mine had introduced some negative impacts, it also provided a clear separation of the mining area from the community land. All mining processes were confined within this boundary, preventing community members and their livestock from encroaching into potentially hazardous zones. However, this fencing also restricted access to some grazing pastures and firewood collection areas for local residents.

Due to the enclosed visibility of impacts of the mining operations, most respondents stated that they had not observed significant environmental impacts from the mine.

However, those who had been affected raised concerns about land displacement, dust pollution, and water shortages.

Village head one voiced his frustration regarding land displacement and the loss of grazing land saying:

"*We have been here for 23 years, and this place had become our home. At first, they took the grazing land for our cattle and displaced A1 farmers. Now, they have taken even more land, belonging to three households, for the expansion of the mine. We hear they want to build a lithium processing plant. As we speak, they are already cutting down maize that is not yet ripe with their graders in preparation for the plant. We do not even know how far this clearing will go—maybe we will be affected as well. Our lives are at risk. We are not even certain of our future here. The certainty of our future is no longer clear; maybe we will be removed just like our neighbours*."

Community respondent three from Lawfield expressed deep concern about the displacement, saying

"I am now 81 years old. If they remove me from here, what will I do on the new land? I am no longer energetic to clear land for farming again let alone build a house for myself".

The displaced communities were unhappy with the relocation process. Many were uncertain about the compensation they would receive for their lost maize, as the mine had stated that evaluations would first be conducted by the Ministry of Agriculture before any payments were made.

However, regarding lost land, the affected residents were informed that they would be resettled elsewhere and given $1,000 per month for six months as compensation, an arrangement that they were not happy with.



Fig 9: Maize field being cleared for the processing plant

Source: Author

Concerns about water issues emerged in two main ways:

i. Residents from Lawfield expressed fears of possible contamination of their dam.
ii. Residents from Chinyika, Mapfeni and Gilnockie were worried about their dams drying up faster than before.

Community resident four from Lawfield shared their concerns:

"Since the time we had a fight with them, they are now taking water from Chinyika, Nero and Mapfene dams. We are only crying over the possible pollution of our dam from water that we normally see flowing from the mine into our dam. We do not know what that water contains, maybe it has dangerous chemicals. Our livestock drink from that dam, we also fish and irrigate our crops from the same dam".

While residents raised concerns over possible water contamination, this issue was verified with an EMA official, who indicated that their monthly monitoring results had not detected any contamination in local water bodies so far. However, when participants from Nero were contacted, they confirmed that their dam was drying up more quickly than before. The EMA official acknowledged this but clarified that water abstraction issues fall under the Zimbabwe Water Authority (ZINWA). In their response the EMA official stated:

> *"Yes, we have heard complaints and we can see it but it's in the jurisdiction of ZINWA. On pollution, from our monthly water monitoring, the water quality is still the same. No other degradation has been witnessed yet".*

In addition to water concerns, dust pollution emerged as a major issue for residents of ADA Farm, Murape, and Madhongo villages, particularly those living close to the road leading to the mine. Since this is a dirt road, the frequent movement of trucks to and from the mine continuously generates dust.



Fig 10: Dust road leading to the mine, passing through the villages, Source: Author

Residents indicated that they had raised complaints about the dust issue with their village heads, ward councillors, and EMA officials. Village head two shared his frustration:

> *"They were watering with their bowser to suppress dust but suddenly stopped. We no longer see them and do not know why they stopped. We no longer open windows in our houses because of dust. When we complain, that's when they come and spray, but they don't use much water, so it quickly dries up and the dust continues."*

This suggests that while some mitigation efforts were initially in place, they have since become inconsistent, leaving residents struggling with persistent dust pollution.



Fig 11: Dust laden waterpipe used to draw water from one of the dams.
Source: Author

Residents of Almersfield section also raised concerns about dust, noise, and vibrations, particularly during blasting activities. These complaints were confirmed by

officials from the Environmental Management Agency (EMA), who acknowledged receiving reports from the community. The EMA official stated:

> *"We engaged with the mine to have a tarred road and regular dewatering. Shortage of water during the dry season affected the program. We have also issued fines and orders for dust pollution*"

At the time of data collection, some sections of the road were already under construction, with tarring in progress by the mining company.

Additionally, residents of Nero village, where the mine draws water, lamented the loss of their fishing livelihood. They reported that the lithium mining operations had led to the dam drying up much faster than before, negatively impacting both their fishing activities and irrigation projects. The presence of large water pipes leading to the mine further indicated the substantial water demands of lithium mining, which could be contributing to the depletion of local water sources.

4.4.5 Physical Capital

While no significant changes in physical capital were reported at the household level, concerns were raised by Almersfield section residents about potential structural damage to buildings due to blasting vibrations. However, the construction of Vhuta Primary School classroom blocks and teacher accommodations by the mine was noted as a positive development. This investment is expected to improve the quality of education and contribute to better livelihoods for the community in the long term.

Additionally, the mine provides transport for its employees, though this benefit does not extend to local communities since most workers are from outside the area.

In response to dust pollution complaints and regulatory orders, the mine had already begun tarring sections of the road. This infrastructure development is expected to benefit the local communities, not only by reducing dust-related issues but also by improving transportation. Farmers who sell fresh produce and grains to markets outside Goromonzi will particularly benefit from the tarred road, as it will allow for cleaner, faster, and more efficient delivery of their products.

4.5 Perceptions and attitudes of the community towards the mine with regards changes in livelihood patterns and water availability

The community's primary expectation from the mine was preferential treatment in job opportunities. However, this expectation has not been consistently met. While all respondents acknowledged that, at inception, the mine prioritized hiring locals, 97% indicated that this was no longer the case. Many expressed frustrations over the frequent sight of mine buses transporting workers from outside communities, with none allocated for local residents. This shift strongly suggests that the mine has moved away from employing locals, fuelling resentment within the community. The lack of local employment opportunities has significantly contributed to negative perceptions of the mine. Community respondent five from Ada farm expressed her frustration, stating,

> *"They are mining lithium from our area yet we do not benefit from it. Do you think we will be happy with the mine. Now they say we do not have the necessary skills, how come skills is now a challenge yet when they started, they were employing the same locals"*

Another major unmet expectation was the promised community development initiatives when the mine was established. Residents had been assured that infrastructure such as roads, clinics, and schools would be built to improve their livelihoods. However, many feel that these promises have largely gone unfulfilled. Community respondent six from Chinyika expressed her disappointment, stating,

> *"When they first came, they promised roads, clinics, schools and we were happy with it but nothing much was done expect assisting with the primary school we were already building".*

Another major concern among community members was the lack of consultation and involvement in decision-making on issues affecting their welfare. All respondents living within a 3km radius of the mine expressed strong dissatisfaction with this exclusion. They stated that the mine informs them of planned activities without seeking their input or considering how these actions might impact their lives. Community respondent seven remarked:

> *"The mine does very huge and significant developments which affect us but we are not consulted. Consultation is required with the whole society to get collective*

ideas on what they can do for us which is relevant to us. We are not happy with the mine. We can safely say this mine came to destroy us".

Echoing their concerns, community members from the group in the field expressed deep dissatisfaction with what they perceived as the mine's lack of regard for their well-being.

"Why does the mine want to process lithium over the fence and affect us instead of setting up the plant in a more suitable, unoccupied area? Dorowa mine in Buhera extracts phosphate yet fertiliser is processed in Harare, why should this lithium mine be any different? what's so special about them. The mine should get a piece of land from ARDA (a government farm) which has plenty of unutilised land and construct a processing plant there rather than removing people from their bases. It's very feasible, Dorowa mine is already doing that".

Peculiar to the villages along the road being tarred, one villager from Chinyika had this to say.

"We will cry more from this construction of a tarred road. Trucks from the mine will be speeding more and our children will be knocked down by the trucks".

4.6 Coping strategies adopted by the community to address these impacts.

The community adopted a mix of coping strategies, including not opening windows to reduce the ingress of dust, returning to their original villages with poor soils, reducing their herd of cattle, relocating to towns to seek employment, and engaging in gold panning.

The strategies employed by the community to cope with the impacts were diverse, ranging from mild responses, such as accepting the status quo, to actively fighting with the mine over resources. Respondent from ten from Lawfield said,

"*We had to fight with mine to stop them from drawing water from our dam"*

The community in Lawfield indicated that they had to fight with the mine over the use of water from their dam, while on the other hand, they could only watch as their grazing and burial lands were taken by the mine. Some residents in Lawfield mentioned that they were relocating from their homes to make way for the processing plant. One of

the households set to be relocated stated that they were returning to their rural home, which they had left 23 years ago, hoping their house would still be habitable. Some families had moved their children back to their previous schools due to the fencing of the mine. Community WhatsApp groups served as a strategy to bridge the distance gap created by the fencing. Villages along the dusty road reported that they no longer opened their windows to prevent dust from entering their houses. Community respondents twelve said,

> *"Our children are engaging in gold panning as a source of livelihood since jobs at the mine are difficult to secure."*

The community also engaged the mine through local leadership, such as ward councillors and village heads.

4.7 Potential mitigation strategies.

From this study, it has been noted that addressing the livelihood challenges faced by the communities requires a focus on the most significant concerns raised in the responses. A well-defined framework targeting these key areas will be instrumental in guiding decision-makers and regulatory authorities in managing challenges associated with the new lithium mines during this lithium boom era.

This boom is expected to result in the rapid opening of more mines within a short period. As of 2021, only one lithium mine was operational in Zimbabwe. However, by 2024, seven more lithium mines had been opened and were already in operation (Matanzima, 2024c), with several others under exploration.

The key challenges identified include the displacement of locals, water availability, lack of employment opportunities, and dust pollution. Therefore, a comprehensive framework addressing these critical challenges is essential.

4.7.1 Water resource management

Considering the extensive water pipelines supplying the mine, lithium mining operations should be required to implement alternative water management strategies, such as water harvesting and the construction of dedicated dams, to minimize reliance

on community water resources. Additionally, the establishment of mandatory effluent treatment plants, with a regulated portion of recycled water usage, should be enforced to reduce overall water abstraction levels

4.7.2 Resettlement of displaced households

Communities in Lawfield affected by the mine expressed uncertainty about their relocation, stating that they had not been informed of their future settlement or seen the properties they were expected to occupy. The displacement of households in mineral-rich areas will continue to happen, highlighting the need for preconditions such as the provision of new housing and cleared farming land for resettled families before any displacement occurs. This requirement can be made a mandatory component of the Environmental Impact Assessment (EIA).

4.7.3 Employment of locals

Given that only 3% of respondents indicated that they or a family member were employed at the mine, this figure is remarkably low. To ensure that local communities benefit from extractive industries in their areas, binding agreements should be established and enforced, mandating a specific percentage of jobs to be reserved for local residents.

4.7.4 Dust management

Resettlement schemes should not only focus on households directly located where the mineral is found but also consider those heavily impacted by mining activities, such as those in the windward direction of the mine. Dust levels should be assessed to identify significantly affected areas. Additionally, the construction of tarred roads should be a mandatory prerequisite before a mine is allowed to operate to minimize dust pollution caused by truck movements

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Introduction

The aim of this research study was to investigate and document the changes in the livelihood experiences of the Arcturus rural community in Zimbabwe following the onset of mining activities, as well as to assess how the environment as it related water availability had been impacted. This chapter discusses the research findings presented in Chapter Four in relation to the arguments and studies reviewed in Chapter Two on literature review. To ensure a systematic discussion, the research objectives have been used as headings.

The sustainable livelihoods framework was employed to analyse the impacts of mining activities on both livelihoods and water resources. Literature on the establishment of new mines indicates that such developments have both positive and negative effects on the communities living in proximity to the mines (Wilson *et al*., 2022; Matanzima, 2024b). Given that mining projects have a finite lifespan (Dorn and Gundermann, 2022), ensuring sustainable and long-term benefits for local communities is essential.

5.2 Socio-economic and environmental impacts of the lithium mine on livelihood patterns and water availability

This study has demonstrated that the changes in livelihoods resulting from the lithium mine largely align with findings in existing literature. Generally, changes were observed on all the five capitals under the SLF. These changes agree with what is highlighted in literature. Main common changes include displacement of local communities, loss of grazing land, dust pollution, and conflicts over resources have all been widely documented in previous studies.

5.2.1 Financial Capital

The community benefited financially to a less extent from the mine. While literature talks on job creation for locals and improvements in local businesses, findings from this research show that this was to a very limited extent.

While other studies suggest that new mines benefit communities through job creation (Wilson *et al*., 2022; Canelas and Carvalho, 2023; Mkodzongi, 2024), this study indicates that this is not always the case. The number of job opportunities created for locals was minimal, aligning with findings by Shoko and Mwitwa (2015) and Liu and Agusdinata (2020). Only 3% of respondents reported being employed at the mine, a figure too small to reflect a meaningful livelihood transformation. Furthermore, all respondents indicated that the mine primarily imports labour from neighbouring towns, citing the frequent transportation of employees by mine staff buses to distant locations outside their communities as evidence. As such, with only two respondents indicating that they had benefited, financial assets of the community cannot be said to have been changed by the onset of the mine.

Literature is abundant with evidence suggesting that the establishment of mines leads to improved local business opportunities. In their study in Chile, positive benefits on local economic development arising from lithium mining was highlighted (Liu and Agusdinata, 2020). However, in contrast to these findings, none of the local businesses interviewed in this study reported experiencing any growth due to the mine. This could be attributed to the mine's employment strategy, which primarily hires workers from outside the neighbouring communities. A notable exception was a small group of women operating mobile food stalls, selling cooked meals mainly to truck drivers waiting for loads and individuals seeking job opportunities at the mine.

5.2.2 Human Capital

Improvements in education of the communities' children were noted from payment of school fees by the mine. This relieves the households of some money which they can use for other needs. This agrees with findings from in which they pointed that mining companies are helping communities with education. From this perspective, the human capital of the community can be projected to improve in future from an educated community.

5.2.3 Social Capital

The lack of community involvement in the mining project on matters affecting their livelihoods was a significant concern. None of the respondents interviewed reported being meaningfully consulted or engaged by the mine. This aligns with findings by

ZELA (2023), which highlighted limited consultation of local communities in lithium mining projects as well as findings by Saleth and Varov, (2023) on communities living near the mine feel restricted in decision-making processes. Lawfield communities indicated that the mine had concluded with the chief on this issue of exhumation of graves. Their indication that representatives from the Ministry of lands were the ones on the forefront informing them of the displacements that were to occur. Both revelations align with findings by Pilcher *et al*., (2017) who noted that mining companies were rather negotiating with the government, and traditional leaders instead of affected communities. This indicates that with the onset of the mine, the community was negatively affected on this aspect.

Conflicts over water use raised by the Lawfield community are also not unique to this study. Similar conflicts between indigenous communities and mining companies over water have been noted in Chile, as highlighted in a study by Dorn and Gundermann (2022). The issue of pollution and water depletion identified in this study also aligns with findings in the literature, which report the contamination and depletion of water bodies due to lithium mining (Cleote *et al*., 2023). Again, another negative impact on the livelihood of the community coming from the mine.

5.2.4 Natural Capital

The displacement of locals from their land saw losses in land, grazing land, water and crops. Displacements due to new mining projects has significant detrimental effects on affected households (Vanclay, 2017; Aronsson and Price, 2024), and lithium mining is no exception (Matanzima, 2024a; Vivoda *et al*., 2024). These displacements, widely documented in the literature, have also been experienced by the Lawfield community. Residents of Lawfield, where the mine is located, have been displaced twice since the onset of mining activities. Those who remain express uncertainty about their future, fearing further displacement.

Initially, the mine displaced households whose land contained lithium deposits. More recently, a second phase of displacements has been carried out to create space for the construction of a lithium processing plant adjacent to the mine. This has negatively impacted the community's livelihoods in multiple ways, including the loss of social connections, farmland, grazing land, and burial sites. These disruptions to livelihoods

caused by displacement and resettlement were also highlighted by Kemp *et al*., (2017). Similarly, Matanzima (2024b) reports that communities displaced by the establishment of the Sabi Star lithium mine in Buhera, Zimbabwe, suffered significant losses, including farmland and livestock. This indicates a negative change in the livelihoods of the community with the coming of the mine.

Water availability - Lithium mining is particularly associated with significant water abstraction (Liu and Agusdinata, 2020; Dorn and Gundermann, 2022; Vivoda *et al*., 2024), a trend also observed in this study of the Arcadia lithium mine. Residents in areas where the mine draws water reported that their local dams were drying up. Water scarcity affects various livelihood activities, including livestock farming and irrigation projects that depend on this resource (Pilcher *et al*., 2017). This could be attributed to the fact that extracting lithium from hard rock requires large volumes of water per ton of lithium produced (Kashwan and Jayaram, 2023). The high demand for fresh water in lithium mining also contributes to the depletion of aquifers (Pilcher *et al*., 2017), which may explain the installation of large water pipelines to supply the mine. Access to water and associated services like fishing and irrigation were thus negatively affected by with the onset of the lithium mining activities at Arcturus.

5.2.5 Physical Capital

While no improvements were noted on personal assets by the communities attributed to the mine, this could be because the community is not employed by the mine and not getting any financial benefits. The mine had assisted in building the school and houses for the teachers at a local primary school. The mine was also in the process of constructing a tarred road from the mine to Goromonzi RDC. Community development has also been noted in other lithium mining communities (Wilson *et al*., 2022; Saleth and Varov, 2023; Liu and Agusdinata 2020). The community also noted the one tonne water containers they received from the mine. As such no significant change to community livelihoods can be attributed to the mine.

5.3 Perceptions and attitudes of the community towards the mine

The views and feelings of the communities regarding the mine are consistent with those mentioned in research. However, the community is more negatively inclined toward the mine than positively. They have experienced more negative impacts than

benefits, which explains their dissatisfaction with the mine and its conduct. Communities living near mining sites have suffered greater negative effects on their livelihoods due to mining activities (Saleth and Varov, 2023). This aligns with observations from communities surrounding the Arcturus lithium mine, where residents perceive the mine as a threat to both their current and future livelihoods.

The majority of respondents from the interviewed communities felt powerless and unable to oppose any decisions imposed by the mine. They also expressed frustration over their inability to report their grievances, as they believe the government sides with the Chinese mine owners. This finding is consistent with Saleth and Varov (2023), where communities reported their inability to assert their demands at the national level.

5.4 Coping strategies adopted by the community to address impacts

The coping strategies adopted by the community are similar to those observed in other studies. However, unlike in some cases where communities have resorted to violent strategies to defend their rights (Dorn and Gundermann, 2022; Diaz *et al.*, 2023), this community has largely pursued non-violent means. The only notable conflict was the refusal to allow the mine to extract water from Lawfield Field. The community actively opposed the mine's access to the dam, making their grievances heard until the mine was forced to remove the pipes and pumps it had installed.

To cope with the mine's impacts, displaced families are relocating to new resettlement areas, while some are returning to their original homes. This also tallies with findings from Matanzima (2024b) on displaced communities. Others have opted to seek employment elsewhere, while some have turned to gold panning, taking advantage of the region's artisanal mining activities.

5.5 Potential mitigation strategies

Key challenges noted from the research require a robust and systematic strategy to address them. Based on the findings, the focus of the mitigation strategies needs to consider issues such as planned resettlements of displaced households, set levels of compensation for displaced and affected households, employment opportunities for local communities, water resource management, dust management, as well as local community engagement, consultation, and participation. These areas were significant

in this research and in other studies noted in the literature. Therefore, setting strategies that address these issues will go a long way in reducing negative impacts on the livelihoods of the communities.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

This research sought to investigate the changes in the livelihood experiences of the Arcturus rural community in Zimbabwe and the environmental impact, particularly on water availability, following the onset of lithium mining activities at the Arcadia Lithium Mine Project. The conclusions drawn are based on the four key themes derived from the research questions.

a) Mining socio-environmental impacts

The study found that the lithium mining boom has negatively affected both community livelihoods and water availability, impacting all five livelihood capitals. Overall, the communities' livelihoods did not improve following the establishment of the mine in their locality. Key livelihood activities affected included the loss of farmlands, grazing areas, fishing grounds, and reduced social interactions. The most affected community was Lawfield, where the mine claim is located. This community suffered losses across all five livelihood capitals, with the most significant impact being displacements of households and reduced grazing lands.

Fishing was particularly impacted in the Chinyika, Mapfeni and Grenoki communities, where the mine sources its water, evidence that lithium mining affects water availability. The drying up of dams not only disrupted fishing activities but also affected irrigation projects and livestock rearing, which are some of the key livelihood activities for these communities. Additionally, residents of Aylmersfield reported structural damage to their homes, including cracked walls, due to the mine's blasting activities.

Despite the severe negative impacts, the mine has done very little to improve community livelihoods. No preference was given to local residents for employment opportunities, as most mine workers were brought in from outside Goromonzi. This meant that locals did not benefit from direct employment, nor did their businesses gain from economic activities related to mine workers purchasing goods and services.

However, some positive infrastructure developments were noted, such as improved roads and a local school. These improvements have the potential to enhance other livelihood activities, such as irrigation farming. Communities in Goromonzi engage in horticulture for commercial purposes, and the newly tarred roads will facilitate the efficient transportation of produce in better condition, without the previous challenges of dust contamination.

b) Community Perceptions and Attitudes

Overall, community members were dissatisfied with the mine's presence. Their discontent stemmed mainly from unmet promises and expectations, as well as the negative impacts the mine had on their livelihoods, including loss of land and displacement. Fulfilling the mine's initial commitments could have significantly improved community livelihoods and mitigated some of the negative effects.

c) Communities' Coping Strategies

In response to the mine's impact on their livelihoods and water access, communities adopted several nonviolent coping strategies. These included:

i. Raising concerns with local leadership and regulatory authorities
ii. Shifting to gold panning as an alternative livelihood
iii. Accepting and adapting to the impacts
iv. Protesting against the mine
v. Relocating to other areas

d) Potential Mitigation Strategies

A structured framework is necessary to mitigate the negative impacts of lithium mining on affected communities. This framework should include:

i. Structured resettlement plans for displaced households, with predetermined compensation levels
ii. Mandatory quotas for local employment upon new lithium mining companies
iii. Alternative water sources to reduce the mine's reliance on community resources
iv. Dust management strategies
v. Community development initiatives

vi. Mandatory and frequent engagement with local communities to address concerns and expectations

By implementing these measures, a balance can be achieved between economic gains from lithium mining and the socio-environmental well-being of the affected communities.

6.2 Recommendations

In view of the findings from this research, the following recommendations are proposed:

a) Further Research on Lithium Mining Impacts

It is recommended that further studies be conducted across different lithium mining companies and their surrounding communities to determine whether the impacts observed in this study are widespread. Comparative studies between various lithium mining locations in Zimbabwe would help identify similarities and differences in community experiences, enabling the development of mitigation strategies that can be applied on a broader scale. Such comparisons would enhance our understanding of the socio-economic and environmental effects of the green transition and facilitate the creation of effective policies to mitigate the negative impacts of the lithium boom. Additionally, sharing information on coping strategies across communities would promote knowledge exchange and reduce the burden on affected populations.

b) Expanding Research Scope Beyond Livelihoods and Water Availability

This study focused on the impacts of lithium mining specifically on livelihoods and water availability. However, further research is needed to examine the broader socio-economic and environmental effects on affected communities. Many additional concerns were raised by community members that extend beyond livelihood activities and water access. A more comprehensive assessment of these impacts would provide policymakers with a holistic understanding of the actual consequences of these new lithium mines, rather than relying solely on potential impacted noted from Environmental Impact Assessments (EIAs) reports.

c) Development of a National Lithium Strategy

For policymakers, it is recommended that a structured framework be established for managing and monitoring new lithium mining projects. This includes developing a National Lithium Strategy aimed at balancing economic gains with socio-environmental sustainability. The strategy should specifically address key issues identified in this research, including:

i. Management of displacements and appropriate compensation for affected households
ii. Employment policies that prioritize local communities
iii. Water management to prevent depletion of community resources
iv. Dust control measures to mitigate environmental and health impacts
v. Community engagement through regular consultations and transparency

Currently, different aspects of mining projects are managed under separate governmental departments. Water issues fall under ZINWA, displacements and compensation are handled by the Ministry of Lands, environmental concerns are overseen by EMA and mine development is under the Ministry of Mines. To ensure the effective implementation of a National Lithium Strategy, the government should establish a dedicated oversight body responsible for coordinating and monitoring these aspects, rather than relying on multiple ministries working in isolation.

d) Investment in Local Workforce Development

Mining companies should invest in local workforce development by providing skills training programs for community members. This would equip locals with the necessary qualifications to secure employment at the mines, ensuring that economic benefits are shared with the host communities rather than being limited to external workers.

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APPENDIX I: Consent form

Consent Form

Arcturus community member

Title of project : Livelihoods and natural resource management in fast-track lithium mining in Arcturus rural community in Zimbabwe

Name of researcher : Zanele Guvakuva

I, ……., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that the interview group/other activity may be audio recorded	YES	NO
I agree that direct quotations from my interview may be used by the researcher in their research report	YES	NO
I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report)	YES	NO
I agree that other researchers may use the information I provide in my interview (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on	YES	NO

…… (signature)
…… (name of participant)
…… (date)

…… (signature)
…… (name of researcher/person seeking consent)
…… (date)

APPENDIX II: Ministry of State and Goromonzi Rural District Council Approvals

OFFICE OF THE PRESIDENT AND CABINET

Correspondences Should not be

addressed to individuals

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pamasheast@gmail.com

ZIMBABWE

The Office of the Permanent Secretary for Provincial Affairs and Devolution

Cnr Morris Avenue/Second Street
(P.O BOX 445)
Marondera
ZIMBABWE

REFERENCE:

06 September 2024

District Development Coordinators
Goromonzi
Marondera

CLEARANCE FOR Ms ZANELE GUVAKUVA TO CONDUCT HER RESEARCH ON LIVELIHOODS AND NATURAL RESOURCE MANAGEMENT IN LITHIUM MINE OBJECTIVELY TO UNDERSTAND CHANGES IN LIVELIHOOD EXPERIENCES OF THE ARCTURUS RURAL COMMUNITY IN GOROMONZI: MASHONALAND EAST

This letter serves to confirm that **Zanele Guvakuva** has been cleared to conduct her research in Arcturus rural areas, Goromonzi District Mashonaland East. The researcher wants to collect data from Community members, involving interviewing them. Please note the researcher is cleared to do **ONLY** study related interviews for academic purpose.

Thereafter, you are also obliged to share your research finding with the District Development Coordinator and the Minister of State for Provincial Affairs and devolution Mashonaland East for the benefit of the Government of Zimbabwe

S Chinyamakobvu
For: Secretary for Provincial affairs and Devolution
Mashonaland East Province

OFFICE OF THE PRESIDENT AND CABINET
MIN. OF STATE FOR PROVINCIAL AFFAIRS AND DEVOLUTION
05 SEP 2024
PERMANENT SECRETARY'S OFFICE
MASHONALAND EAST PROVINCE
ZIMBABWE

cc- District Development Coordinator Goromonzi District

OFFICE OF THE PRESIDENT AND CABINET

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05 SEP 2024
PERMANENT SECRETARY'S OFFICE
MASHONALAND EAST PROVINCE
ZIMBABWE

cc- District Development Coordinator Goromonzi District

The DDC's office has no objection to the research. Can you please kindly assist Zanele with relevant information to furnish her research. Thanks

DISTRICT DEVELOPMENT COORDINATOR
GOROMONZI
31 OCT 2024
P. BAG 45, GOROMONZI
ZIMBABWE TEL 1253

APPENDIX III: Research Questions

Semi Structured – Community member

Name/Identity of respondent:….....

Age group of respondent:….....

Gender group of respondent:….....

How long has the respondent been staying in the community:….....

What is the role of the respondent in the household:……..

Does the respondent stay in the community permanently or come during certain periods only:…….

How far from the mine is the household……..

1) What is your main source of livelihood in this community?
2) How do you make a living in this community
3) What are your sources of income
4) How has the mining operations from the time it started until now affected your way of living.
5) What changes have you noted in the following livelihoods areas?
   - Human capital (education, decision making, labour)
   - Natural capital (renewable and non-renewable natural resources like farmland, water resources, grazing pastures, access to forest resources, state of forest cover, environmental degradation)
   - Physical capital (tangible assets like farm equipment, machinery, buildings)
   - Financial capital (monetary and investments, cost of living)
   - Social capital (social structure, interactions and engagement systems, growth of local business, prices of goods)
   - Other areas (specify)
6) How have you adjusted to keep surviving and living a comfortable life
7) What changes have you noted on the environment and natural resources management?
8) Are there any complaints or concerns you have raised to the village leadership or local authorities about the mine? If so, which ones
9) What would you desire to see the government, or the mine do to improve the way you are living