Influence of Mining Operations on Quality of Life of Local Communities

A Case Study of Extensive Open-Pit Mining in Chingola, Zambia

Local football training ground next to Chingola's copper smelter.

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Abstract

While mining operations play a crucial part in local development and employment world wide, it also raises substantial social, economic, and environmental concerns. Prior studies have shown mixed impacts of mining on communities, highlighting benefits like economic stimulation against drawbacks such as environmental degradation and health risks. This duality forms the crux of existing literature but lacks detailed exploration, as research assessing both the negative and positive influences, as well as its influence on the overall quality of life in local communities is scarce, especially within the context of Africa. Moreover, the decarbonization of the global energy transition cannot occur without African resources. Therefore, this study employs a Mixed Method Approach (MMA) to investigate the influence of mining activities on the quality of life of local communities, focusing on an open-pit copper mine in Chingola, Zambia. The findings indicate a wide range of negative environmental and social impacts, as well as some positive social and economic impacts. The data further reveals an unequal distribution of these impacts within the community. Those living in close proximity to the mine, often less educated and with higher unemployment rates, suffer the most from the negative effects. It also highlights the absence of accessible and reliable compensation processes. Furthermore, training- and job opportunities provided by the mine are primarily perceived by male workers. The data also highlights that economic satisfaction has a greater impact on quality of life than environmental satisfaction, showing the importance of employment for the community. However, the amount of employment opportunities and Corporate Social Responsibility (CSR) is heavily dependent on the success of the mine, as times of adversity can increase the crime rate and reduce the amount of CSR.

Figures and tables

Figures

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Maps

Abbreviation

MMA	Mixed Method Approach
ASM	Artificial and Small scale Mining
CSR	Corporate Social Responsibility
NMI	Negative Mining Impacts
PMI	Positive Mining Impacts
MRI	Mining Related Indicators
KCM	Konkola Copper Mines
DC	District Commissioner

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1. Introduction

Energy transition

The impact of global warming and climate change can be seen in every inhabited region in the world and across the global climate system (IPCC, 2021, p.10). The latest assessment by the Intergovernmental Panel on Climate Change (IPCC) (2023, p.10), undeniably attributes global warming to human activities, primarily through the release of greenhouse gases. Even under a low global greenhouse gas scenario, the IPCC (2013, p.18) indicates that it is very likely to exceed the temperature threshold established in the Paris Agreement (2015) of 1.5 degrees celsius (UNFCCC, n.d.). In order to not slip out of reach of the Paris Agreement goals, the United Nations Environment Programme (UNEP, 2022) pledges for enhanced climate change mitigation. This mitigation requires behavioural changes, green policies and new technologies, ultimately contributing to a grand transformation of the global energy industry (COMMIT & CD-LINKS, 2018). The purpose of the energy transition is to reduce greenhouse gases by transitioning from a fossil-based- to a zero-carbon society, in which energy is produced by renewables and used by electricity driven technologies (IRENA, 2023; Vora, 2023). The World Energy Transitions Outlook 2013, made by the International Renewable Energy Agency (IRENA, 2023), indicates that in order to achieve a scenario in which the climate does not exceed the 1.5 degrees celsius, the share of renewables in the final energy consumption need to go from the current 17% to 82% in 2050.

'Green' Fuel

Most of these renewables and 'clean' technologies (systems that drive on electricity instead of fossil fuels) heavily depend on Rare Earth Elements (REE) and critical minerals like lithium, copper, cobalt and graphite (IEA, 2021). According to The International Energy Agency (IEA, 2021), this decarbonization process is therefore expected to cause a massive increase in the demand for mineral resources, estimating that the demand over the next two decades is likely to increase by over 40% for copper and REE, 65% for nickel and cobalt and almost 90% for lithium (in a scenario that holds the 1.5 degree celsius threshold). This is not seen as a surprise, as an electric vehicle typically demands six times the mineral inputs compared to a traditional car, and onshore wind facilities require nine times more minerals than a gas-fired plant (IEA, 2021). The World Mining Data 2023 report by Reichl & Schatz (2023), shows that most of these minerals have already seen an increase in production compared to previous years. The extraction of these minerals have even been estimated to affect around 57.000 km2 worldwide (Maus et al., 2020). Although a substantial amount of these minerals are extracted in order to facilitate a more sustainable way of living, it also has its 'dark' side, as human mine-related activities also poses inherent challenges and issues to both human and non-human life (Findlay, 2020; Mononen et al., 2022). The main challenges are centred around health impacts, environmental pollution, economic inequality, and violence (see 1.2.1).

The importance of / for Africa

Besides challenges, mining can also bring benefits with it, as can be seen in the revenue of the top 40 biggest mining companies, bringing in a total of $1.2 trillion dollars in 2022 (PricewaterhouseCoopers, 2023). Furthermore, mining is a big employment source with an estimated 45 million people directly, and 134 million people indirectly working in the mining industry (World Bank, 2020; World Bank 2019). Mining is especially a vital source of employment in Africa, with 14 out of the 26 mining-dependent countries located on the continent (Bauer, 2023). In general, Africa holds around 30% of the world's mineral reserves (Mo Ibrahim Foundation, 2023), and contains the largest reserves of cobalt, diamonds, platinum and uranium worldwide (UNEP, n.d.). It also holds substantial reserves of bauxite, chromium, gold, iron, copper and lithium (OECD, 2023). Most of the mineral reserves in Africa are even largely unexplored. (United Nations, 2011). The importance of the continent in terms of mineral production can also be seen in the fact that it produced 73% of the world's copper (Reichl & Schatz, 2023), which plays a crucial role in renewable energy systems, contributing to the generation of power from various sources such as solar, hydro, thermal, and wind energy (Mo Ibrahim Foundation, 2023). Compared to traditional systems, many renewable energy setups contain approximately 12 times more copper. Decarbonization on a global scale is therefore simply impossible without the active involvement and contribution of Africa (Courage, 2022; African Development Bank Group, 2023; OECD, 2023). However, it's noteworthy that 8 African nations are included in the list of the 20 countries most vulnerable to an economic downturn in the mining sector (Strachan, 2021), and although African mining codes have undergone changes over time, regulations concerning mineral exploration and development in various African nations often still lack clarity, exhibit inconsistencies, and prove to be unpredictable (Lane & Reggio, 2013), thereby fueling and exacerbating social, economic, and environmental problems (Renzi, 2021).

The importance of research

As the extraction of the minerals needed for the energy transition cannot happen without local impacts (Mononen et al., 2022), and in order to steer the ongoing energy transition in a direction that is not only sustainable but also socially, economically, environmentally, and spiritually ‘just’ (Hund et al., 2020), examination of the consequences of mining is needed. Existing research has primarily focused on identifying the social, economic, and environmental impacts of mining on local communities (see 1.2.1). However, there is a lack of studies examining the relationship between these impacts and the quality of life of local residents. While in fact, knowledge about the impact of mining on quality of life is important as it could help develop sustainable and equitable policies needed to prevent a potential degradation of quality of life (e.g. planning new mining projects) and treat (e.g. support/compensation) an ongoing degradation of quality of life. Available research on this topic shows mixed results, with some highlighting the benefits and others more the costs (Dikgwatlhe & Mulenga, 2023; Li et al., 2017). A comprehensive analysis that combines statistical data on quality of

life aspects with people's perceptions on the positive and negative mining-induced impacts is lacking. Moreover, no studies have analysed this relationship in the context of Zambia, which holds Africa's largest copper reserves (World Bank, 2011) and is one of the world's largest exporters of unrefined copper (Mo Ibrahim Foundation, 2023). Therefore, this research aims to provide a comprehensive understanding of the potential impact of mining on the quality of life in mining communities by analysing the impact of an extensive open-pit copper mine in Chingola, Zambia, using a Mixed Method Approach (MMA).

1.1 Research question

The question that acts as the guideline in this paper is as follows: ***how is the quality of life affected by the presence of a copper mine (and its temporary halt) in Chingola town?*** To address the main research question, several sub-questions have been explored. These include:

- What is the perceived impact of the mining presence? And which positive and negative aspects do residents link to it?
- How are the perceived benefits and costs of mining distributed within the community?
- How is satisfaction with the mine distributed within the community? And how is this related to the overall quality of life?
- How does life satisfaction across various domains influence the overall quality of life in Chingola? And what role do mining operations play in this?
- Is the mining in Chingola done in a socially responsible and sustainable way? And how can this be improved?

Before addressing these questions, it is important to provide an overview of the impacts of mining, quality of life, and the existing research on the relationship between these aspects.

1.2 Theoretical Framework

1.2.1 Social-, Economic- and Environmental impacts of mining

Environmental

Plenty of research has been done on the environmental impacts of mining sites. The leakage of heavy (toxic) metals into the environment is one of the biggest problems as it forms a threat for both humans and non-humans living near the mine (Dlamini, et al., 2013; Carrington, 2020; Leuenberger et al., 2021). The soil and water often remains intoxicated even after the mine has been abandoned (Bell et al., 2001; Ekosse, 2001). In terms of pollution, Sulphur Dioxide, which is produced during the smelting process, is one of the major issues, as it later causes acid rain (leading to more deforestation and the acidification of water and soil) and health implications (Akçıl & Koldas, 2006; Queensland, 2023; NASA Earth Observatory, n.d.). Mineral mining also causes direct and indirect deforestation (Giljum et al., 2022), contributing to a significant amount of CO_2 emissions (Trucost, 2016). The World Wide Fund for Nature (WWF, 2023) even estimates that about 8,600 km² of forest was lost between 2010 and 2020 due to mining expansion.

Social

Mining activity is also associated with health impacts on local communities (Leuenberger et al., 2021). These health impacts are primarily caused by water contamination, exposure to dust and toxins, poor working- and living conditions, and accidents. This often leads to respiratory complications, silicosis, HIV infection, tuberculosis and a higher mortality rate (The World Counts, n.d.; Wang et al., 2022; Basu et al., 2015; World Bank, 2014; Bloch et al., 2018; Corbett et al., 2000; Leuenberger et al., 2021). Mining can also cause an increase of inequality between men and women (Oxfam Novib, 2023), and mining dependent and non-mining dependent households (Carrington et al., 2011). Mining migrants can furthermore also exaggerate harassment against women (Oxfam Novib, 2023), and decrease social stability (Bainton et al., 2017). Furthermore, countries rich in natural resources are often characterised by corruption, authoritarian repression and conflict (Stewart A, 201; Carrington et al., 2011). This could cause a lack of control over essentials, abuse, rape, as well as displacement (Global Policy Forum, 2005–2019; Wilson, 2019; Gukurume & Tombindo, 2023; Ofori et al., 2023; Médecins Sans Frontières, 2016; GIZ, 2020).

Economic

The World Bank (2020) estimates that artificial and small-scale mining (ASM) employs at least 45 million people across 80 countries, with an additional 134 million in mining related industries (World Bank, 2019, p.71). In 2022, the top 40 mining companies collectively generated around $1.2 trillion (PricewaterhouseCoopers, 2023). However, many developing countries do not benefit economically

from the mining activities in their country, leading to economic stagnation or contraction (IMF, 2021; Carley et al., 2018). Nevertheless, mining remains a critical non-farming activity in rural areas of the Global South, providing jobs and opportunities for skill development (World Bank, 2019; Carrington et al., 2011). The mining sector also often helps the host country in developing infrastructure networks (Mancini & Sala, 2018; Simutanyi, 2008). Furthermore, mining often stimulates the demand for services, products, and housing (Emuze & Hauptfleisch, 2014), and although this can drive-up living costs, it could also depress housing prices due to negative social and environmental impacts (Williams, 2011; Chomba et al., 2020; Neelawala et al., 2013; Lavee & Bahar, 2017; Kim & Harris, 1996; Trigg & Dubourg, 1993). Additionally, mine workers often face income uncertainty due to the varying phases of mining (Jønsson & Fold, 2009).

As evident from this section, mining, despite its economic benefits, is predominantly linked with negative environmental, social, and economic issues. This is often referred to as the "resource curse" (Fernando, 2022), a term describing how mineral-rich countries are exploited by developed nations, leading to environmental, social, and sometimes even economic degradation.

1.2.2 Quality of Life

Definition

There is a wide range of definitions to the concept of quality of life (Estoque et al., 2018). According to Teoli (2023), quality of life is a “concept which aims to capture the well-being, whether of a population or individual, regarding both positive and negative elements within the entirety of their existence at a specific point in time”. Quality of life is therefore an important concept in assessing the livability of an area (Bhatti et al., 2016).

Approaches in measuring Quality of Life

When determining people's quality of life, the Gross Domestic Product per capita, including the Net income from abroad (GNP), is a common approach (Nussbaum & Sen, 1993). The GNP provides an overview of the performance of the economy (European Union, n.d.), and is often associated with the well being of citizens (Kula et al., 2010; Callen, 2019; Oulton, 2012). The idea that well-being could be comprehend based on objective conditions such as the availability of resources arise from the work of Titmuss (see Erikson, 1993) and Drewnowski (1974), as to them, the objective indicators are more important than the evaluation of them (subjective satisfaction). The use of objective indicators rests on the idea that evaluating living conditions involves comparing real situations against external normative benchmarks like values or goals. According to Boelhouwer & Noll (2014), for such assessments to be viable, three prerequisites must be met: a political consensus on the relevant dimensions for welfare, an agreement on distinguishing between favourable and unfavourable

conditions, and alignment on the direction society should pursue. Such a ‘universal’ list on the most important aspects of life could be seen in Nussbaum's objective list theory (2007), which represents aspects that are universally worthwhile as it “lodges happiness outside of feeling and onto a list of ‘truly valuable’ things in the real world” (Seligman & Royzman, 2003).

Despite objective approaches, commonly focused on levels and conditions as income, education, relations and safety (Lee Kum Sheung Center for Health and Happiness, 2021), seem to be somewhat aligning with the real well-being of people (Killingsworth, 2021; CBS, 2019; Strong et al., 2019; Cornaglia et al., 2014), Seligman & Royzman (2003) criticise such a ‘universal’ and objective approach as it neglects feelings and desires. Therefore, these kinds of ‘objective approaches’ are widely criticised for its inability to comprehend and represent the real well being of citizens (Noll, 1996; I. Vaca et al, 2022; Dynan & Sheiner, 2018; Stiglitz et al., 2008). It also doesn't take into account other aspects that societies value (e.g. health costs, education access, environmental impacts, and free- goods and services), and their satisfaction with it (Boyer et al., 2014). Therefore, when conducting research on quality of life, scientists often assess it by considering it as a composite entity comprising various domains (Dedhiya & Kong, 1995). These domains are not universally constructed, but often related to the World Health Organization Quality Of Life Questionnaire (WHOQOL-Bref) indicators, which is a commonly used measurement instrument in assessing quality of life (Kalfoss et al., 2021), at it focuses on people's satisfaction “of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”, and makes use of the following domains: physical, psychological, social relationships, and environment, which all make use of a list of sub-indicators (World Health Organization, 2012). The WHOQOL-Bref is derived from the more extended WHOQOL-100 questionnaire, which also covers levels of independence and spirituality/religion/personal beliefs (World Health Organization, 2012). . In general, the WHOQOL models are seen as reliable instruments in measuring people's quality of life (Gholami, 2013; Kalfoss et al., 2021; Skevington et al., 2004), as the satisfaction of people might reflect the difference between people's desires and their ability of realisation, which is according to Sen's capability approach (see Stanford Encyclopedia of Philosophy, 2011), one of the most important aspects shaping people's quality of life, as people with the same amount of resources might not be able to convert them into similar ‘beings’ and ‘doings’.

Although objective and subjective ways of measuring quality of life seem to be somewhat correlated (Macků et al., 2020; Am, 2001; Li et al., 2017), researchers sometimes still indicate significant differences (Cummins, 2000; Noronha and Nairy, 2005; Kubiszewski et al., 2018; Li et al., 2017; Hayhurst et al., 2014; Perry & Felce, 2005). Therefore, when assessing people's quality of life, it's good to take into account both objective- (level and condition) and subjective (satisfaction) measurements.

1.2.3 Previous research on the impact of mining on quality of life

Previous research done on the impact of mining on the quality of life show both positive and negative effects. Dikgwatlhe & Mulenga (2023) found that individuals in South-Africa express a positive effect of mining on their quality of life, predominantly attributed to employment opportunities and the enhancement of skills through training programs. The study made use of a survey in which quality of life was encapsulated within a single question and did not identify the relationship between mining impacts and various quality of life domains. Hajkowicz et al. (2011) also highlighted the positive impacts when exploring the relationship between mining and well-being in Australia's mining regions. They took improved income, housing affordability, communication access, educational levels, employment and life expectancy as well being indicators, and found out that solely the last indicator didn't have a significant positive relationship with the gross value of mineral production. However, the study did not include negative mining impacts, thereby overshadowing prevalent issues such as the unequal distribution of mining benefits in many local mining towns (Carrington et al., 2011).

Noronha and Nairy (2005) did a more in-depth analysis by comparing subjective (satisfaction) and objective (level of resources and conditions) measurements between a mining and non-mining town in India. They only found a significant difference in the biophysical domain, in which residents from the mining town demonstrated a lower satisfaction, primarily due to pollution. Furthermore, the objective differences between a mining and a non-mining town were bigger than the subjective measurements, suggesting that a lower level of resources and conditions do not necessarily reflect lower satisfaction levels. By conducting research on the impact of coal mining on the wellbeing of host communities in a mining province in China, Li et al. (2017) also highlight the importance of incorporating both objective and subjective indicators to investigate quality of life, as some objective measurements where found to be good predictors for the subjective quality of life, and others not. The subjective indicators highlighted the negative impact of coal mining on water safety, inflation rates, the cost of necessities, and income inequality, and the positive impact on housing conditions. However, both studies only compared mining and non-mining towns, without providing a deeper understanding of how these differences impact the general quality of life for people living near the mining areas.

Li et al. (2019) did try this in their study on the impact of coal mining on the life-satisfaction of host communities. Through a survey, which made use of Individual/family capital, community capital, institutional capital, economy, living conditions and natural environment as domains, it was discovered that proximity to coal mining positively influences satisfaction with living conditions but adversely impacts overall life satisfaction. This phenomenon is primarily ascribed to the health impacts induced by coal mining. While the study did consider many non-mining factors, it overlooked some of the mining impacts (e.g. income insecurity) as well as aspects such as proximity to services

and housing conditions, which all are scientifically linked to well-being (Appendix A, Table.9). Furthermore, all the aforementioned studies only used quantitative data, lacking a deeper understanding of the impact of mining activities on the quality of life within mining communities.

1.2.4 Knowledge gap

Overall, established research points out the economic benefits and social- and environmental costs when identifying the positive and negative impacts of mining on the quality of life of local residents, with some highlighting the benefits and others the costs. A clear in-depth MMA, which incorporates residents' objective conditions and subjective perceptions of the positive and negative mining impacts, as well as statistical data on its influence on the quality of life, quality of life domains, and mining satisfaction - by integrating mining and non-mining related factors - is lacking, primarily in the African context. Moreover, no studies have tried to analyse this relationship in the context of Zambia, which importance is further elaborated on in section 1.4.

1.3 Conceptual Framework

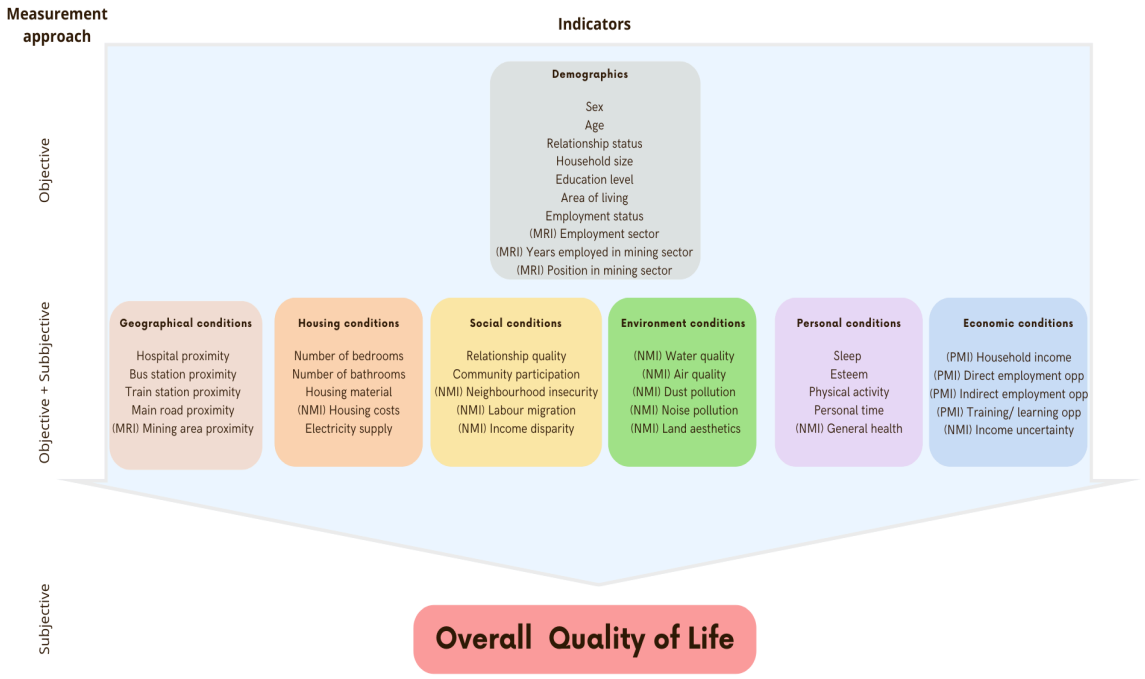


Fig.1| *Comprehensive Research Framework; *Opp = opportunities.*

To fill in this knowledge gap, the aforementioned objective and subjective quality of life approaches (see 1.2.2) have been combined with mining and non-mining related factors (Fig.1). The mining related factors consist of well known positive (PMI) and negative (NMI) mining impacts (see 1.2.1), and mining related indicators (MRI) - demographics that previous research have found to be significant in determining the influence of mining on the quality of life (see 1.2.3). The non-mining related factors are scientifically proven to influence overall quality of life (see Appendix A, Table.9) and mostly align with the WHOQOL-100 indicators. The non-mining related factors are included to reduce potential confounding effects when statistically measuring the influence of PMI, NMI, and MRF on the quality of life and to create a better understanding of the quality of life in general. PMI, NMI and MRI have been summarised in Appendix D, Table.10.

The PMI, NMI, MRI, and the non-mining related factors fall within the six quality of life domains, which are Geographical-, Housing-, Social-, Environment-, Personal-, and Economic conditions, or within the demographic section (Fig.1). This particular division of classifications is inspired by the domains used in the WHOQOL-100 and the research done by Li et al. (2019), as it helps to combine the mining related factors and non-mining related factors into similar categories. Some mining impacts (e.g. water pollution) also align with indicators used in the WHOQOL-100, making it more appropriate to use this approach. By utilising these domains, and combining them with the mining and non-mining related factors, the framework encapsulates the most significant variables for measuring the mine's impact on quality of life.

1.4 Regional context

For the past five years (2016-2020), Zambia has held the position of the world's largest exporter of unrefined copper (Mo Ibrahim Foundation, 2023), accounting for over 70% of the country's export revenue (International Trade Administration, 2020). The mining sector and its associated sub-sectors are thus crucial drivers of economic activity and employment in the country (Standard Bank, 2023).
The recent discovery of a significant copper deposit in the country, described by KoBalt as potentially one of the world's largest high-grade copper mines (Meredith, 2024), has raised concerns in the local community. Residents fear possible socio-economic and environmental impacts, such as water contamination, unequal distribution of benefits, and wildlife displacement (Daily Nation, 2023). These concerns seem to be fair, as studies show that air pollution, the siltation of local rivers, and the leakage of heavy metals into water streams are the main concerns for people near mining activities in Zambia (Fraser & Lungu, 2007; OAG, 2014; World Bank, 2011).

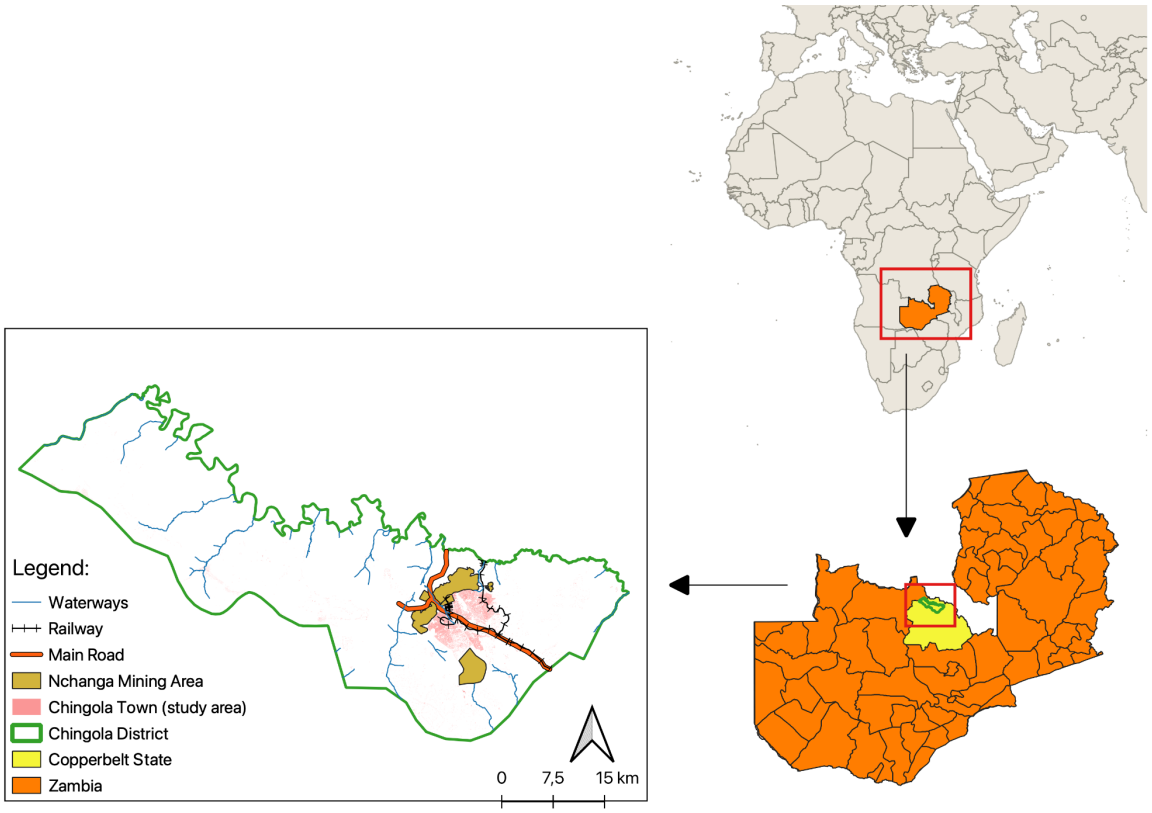
Due to the increasing global importance of copper, the country's dependency on the mineral, its geographical location (Africa), its significant mineral reserves, and the current developments, Zambia has been selected as an appropriate country to use as a case study in this research.

1.4.1 Extensive Open-Pit Mining in Chingola, Zambia

The Central African Copper Belt is a region on the African continent that contains more than 10% of the world's copper deposits (Britannica, 2009). A part of this belt is located in northern Zambia (Geology for Investors, 2017), which is known as the Copperbelt province. This area holds the largest reserves of copper in Africa and approximately 6% of the global copper reserves (World Bank, 2011).
Chingola, a city with a population of approximately 150.000 (WorldpopulationReview, 2023), is located in the northern part of the Copperbelt province, directly next to a mining area (Map.1). Given Chingola's strategic location near the northern border, it serves as a logistical hub for trade between Zambia and the Democratic Republic of Congo (Blaszkiewicz, n.d.).

Over the years, Chingola has experienced both the benefits and challenges associated with mining activities. The economic prosperity driven by copper extraction brought growth and infrastructure development (Mapp, 2023), but also raised environmental and social concerns (Malama, 2020). Despite several upgrades to mitigate negative impacts, such as the modernization of the copper smelter (Mwaanga et al., 2019; World Bank, 2011b & 2021), recent research continues to reveal significant adverse effects of mining in Chingola (Ruhiat, 2023; Malama, 2020; Lusonde & Mubanga, 2019). Additionally, although mining remains the main source of employment for locals, Kolala and Umar (2019) found that over 33% of jobs were lost in four years due to high production costs and mechanisation of the mining process. According to them, residents have linked the job loss to

increased crime rates, alcohol abuse, and prostitution among the youth. Furthermore, the recent discovery of a new copper deposit, located just 24 km north of Chingola (Meredith, 2024), could potentially exacerbate existing issues by attracting more mining activity to the city.



Map.1| *Case study location in an Africa perspective (data extracted from: DIVA-GIS, n.d.).*

The main mine in question is the Nchanga open-pit mine, a copper (and cobalt) mine owned by Konkola Copper Mines (KCM) (PorterGeo, n.d.), a subsidiary of Vedanta Resources, which is an Indian London Stock Exchange listed FTSE100 diversified metals and mining company, with revenues surpassing USD 6.5 billion (Institute of Developing Economies, 2009). The mine, active since 1955, is the largest open pit mine in Africa and the 2nd largest in the world (Pilot Guides, n.d.). Besides copper and cobalt, Vedanta Resources produces aluminium, zinc, lead, iron, and commercial energy (Institute of Developing Economies, 2009), therefore facilitating the transformation of the global energy industry. Besides the Nchanga open-pit mine, there are several small-scale mining sites under control of KCM or the government, such as the Senseli open-pit mine. These sites, former mining dump locations, currently offer opportunities for small-scale entrepreneurs and illegal miners to extract minerals.

Recently (June, 2023), the KCM had suspended the Nchanga Copper Smelter, which is also stationed in Chingola, after a leakage incident (Lusakatimes, 2023). This has not been the first time; as in 2019, over 200 schoolchildren and 43 miners were rushed to the hospital after inhaling sulphur dioxide from KCM's Copper Smelter (Business & Human Rights Resource Centre, 2019). Additionally, in 2015,

2.500 residents filed a claim against KCM for toxic pollution caused by water discharged from the Nchanga Copper Mine in 2006 (Princewill, 2023 - see 'The Supreme Court For Zambia. (2015)' for the jurisdiction), and in 2007, approximately 50.000 residents of Chingola were left without drinking water following a leakage incident (Reuters, 2007). These examples underscore the inherent risk faced by Chingola residents.

After the Zambian governments accused KCM in 2019 of violating its operational licence (referring to the numerous accidents) and failing to pay all its taxes, the government had placed KCM in liquidation (AfricaNews, 2023), leading to a four year court battle. This period of uncertainty was followed by an abrupt halt to nearly all mining operations in December 2023, due to a mining accident at one of KCM's open-pit mines in Chingola (Tembo, 2023), which claimed the lives of an estimated 30 miners (LusakaTimes, 2023b). However, according to the latest updates, the mining operations are soon to be restarted at full capacity as Vedanta has regained control of KCM and is now seeking investments to restart KCM's operations (Dalmia, 2024). KCM has also been promising to invest an annual $20 Million in the local community through Corporate Social Responsibility (CSR) (AfricaNews, 2023).

Due to the mine's significant impact on Chingola residents, the availability of recent scientific literature, the city's population size, its proximity to the mine, the area's relevance, and recent mining developments, this research uses the Nchanga open-pit mine in Chingola, Zambia, as its case study location.

2. Method

2.1 MMA

This study employed a Mixed Method Approach (MMA), meaning it combined the strengths of both quantitative and qualitative research methodologies (Creswell, 2015) to get a better/ deeper understanding of the relationships under research; help explaining contradictions or similarities between the quantitative- and qualitative results; and give people a voice to share their personal experiences while collecting quantitative data (Shorten & Smith, 2017). Quantitative methods are efficient in finding relationships (Creswell, 2015), while qualitative approaches are more suitable for exploring people's experiences, enabling a deeper understanding of perceptions, meanings, and quantitative findings (Hennink et al., 2020).

This research employs a combination of the Concurrent Embedded Strategy (CES) and the Concurrent Triangulation Strategy (CTS) (Creswell, 2015). In practice this means that the quantitative analysis has been used to establish a picture of the quality of life of people living in Chingola, their satisfaction with the mine, the influence of the perceived mining impacts, and the distribution of these impacts within the community. The qualitative analysis is used to validate/contradict these findings, but also to establish a more nuanced picture of the daily mining impacts, mining dependency, social responsibility, sustainability, changes over time, future prospects, and policy recommendations. Both data sources have been collected simultaneously.

2.2 Data collection

2.2.1 Quantitative

The quantitative data has been collected by conducting an survey (Appendix B) in the Chingola Town area (Map.1). By utilising a survey, respondents from various locations can be reached efficiently. Moreover, surveys provide a structured format that enables standardised and specific data collection, thereby aligning the output more closely with the intended research goals (Cornell, 2023). Additionally, the anonymity provided by surveys foster an environment where participants feel comfortable expressing their opinions and experiences truthfully (Hopper, 2010). Overall, the use of a survey in this research enhances the reliability and scalability of the data collection process.

Participant recruitment/sample

To increase the accessibility of the survey, paper copies were created and distributed across various locations in Chingola, particularly in Chingola Central and Nchanga North. To create a diverse demographic study sample, most copies were given to large hotels, shops and churches, as these

locations attract people from all over the Chingola area. Additionally, the paper copies were distributed through local contacts, who shared them with their neighbours and relatives. This approach was chosen because it: 1. Speeds up data collection, 2. Allows for data gathering from unsafe neighbourhoods, and 3. Enhances community involvement in the research process. After re-collecting the paper copies, they have been manually converted into online responses. The online version of the survey was circulated through the use of local contacts, the Chingola Facebook group, and the local radio.

In total, data was collected from a sample of 474 respondents, of which 394 responses were valid (Appendix F, Table.12). The data indicates a diverse distribution among the neighbourhoods in the Chingola town area, with Nchanga North emerging as the most represented neighbourhood (26.3%), followed by Chingola Central (12.6%) and Lulamba (10.3%). The study sample also includes slightly more males (61%) than females (39%), with a mean age of 31 years old. Nearly half of the respondents are employed (49.2%), with the majority working in non-mining related sectors (45.4%), followed by the mining sector (41.1%), and mining-related sectors (13.5%).

Outline of the survey

Before the surveys had been conducted, participants provided consent in alignment with the terms outlined in the consent form (Appendix C). The survey consists of the same domains and indicators as the conceptual framework (Fig.1). In general, the survey is divided into three parts:

I demographics

The survey started with some demographics in order to differentiate between mining- and non-mining dependent households, mining job-ranks, mining job-experience, education level, age, sex, household size, and relationship and occupational status.

II general questions

The respondents were then asked to give their life a satisfaction score ranging between 0 and 100. Next, they were asked to identify the impact of the mine on their quality of life, and their satisfaction with the mining presence. Although research has thoroughly documented the local impacts of mining (see 1.2.1), participants were still asked to identify impacts specific to their area from a predefined list, aligning with Table.1. This step was taken to ensure that the predefined mining impacts resonate with the perceptions of the local community. The list does not include housing price degradation, as this (potential) negative impact has been solely analysed by looking at the impact of mining proximity on the rent prices.

III six quality of life domains

Part III of the survey consists of questions which are directly linked with the domains from the framework. All domains consist of both objective and subjective questions, in which respondents first express their situation (objective questions), followed by their satisfaction with the general situation (subjective question). In this part of the survey, all the subjective questions are measured using a Likert Scale, as it is very useful in measuring perceptions, emotions and behaviours (Moura, 2020). At these questions, the respondents were given the possibility of 5 different answers, ranging from 1: Strongly Satisfied to 5: Strongly Dissatisfied. An uneven number of options has been chosen as this allows the respondents to select a 'neutral' value, thus preventing it from being forced into a position (Moura, 2020).

2.2.2 Qualitative

The research also makes use of a variety of qualitative research methods: interviews, a focus group discussion and participatory research. The interviews encompass a diverse range of actors (Appendix F, Table.13) with the aim of illuminating distinctions and/or commonalities between various actor categories. Particularly, the focus lies on comparing governmental and non-governmental actors, as well as mining related and non-mining related actors. Additionally, the study makes use of a focus group discussion, which is an effective method for discerning community standards, perspectives, and behaviours (Patton, 1990). Young adults' perspectives were chosen for the focus group discussion to gain insight into the next generation's outlook on the future of mining. Furthermore, participatory research has been conducted as it helps uncover unspoken social norms and values, provides context of the social setting, and offers a contextual interpretation of the other research findings (Hennink et al., 2020).

Participant recruitment/sample

Fig.2| *Youth Parade (with the copper smelter in the background).*

For governmental, healthcare, farming, direct and indirect mining, and young adult actors, purposive sampling was used to select 'information-rich' participants whose knowledge about the subject contributes to a more nuanced understanding of the situation (Patton, 2002). Random sampling was

applied for non-mining-related actors due to the lack of specific expertise required. Interviews, averaging 37 minutes, were conducted in private one-on-one settings in the field. All were semi-structured, following a predefined set of questions (Appendix J) to ensure coverage of all topics while maintaining space for spontaneity and thorough exploration. The focus group discussion also followed predefined questions (Appendix H). Before data collection, all participants were informed about the research purpose, guidelines, and their rights (Appendix C).

Within the governmental sphere (Appendix F, Table.13), interviews were conducted with the Mayor of Chingola and the District Commissioner (DC), the two highest positions in terms of local governmental responsibility. In terms of the health impacts of the mine, a local nurse and doctor have been interviewed. Regarding the mining impact on farmers, only perspectives from seasonal farmers have been collected. Moreover, interviews were conducted with a diverse array of individuals in the mining sector, including a KCM employee who also engages in small-scale mining entrepreneurship, a former mining employee, a CEO of a mineral trafficking company (referred to as the CEO), and a mining supplier. When looking at the non-mining related actors, data has been collected from individuals with diverse employment backgrounds. Lastly, the voices of young adults are represented by 40 secondary school students with an age between 16 and 18 years old.

Observations have taken place continuously while doing fieldwork. However, a great number of observations came out of the national Youth Day (Fig.2), which was attended by numerous local schools, political figures, political supporters, and KCM employees.

2.2.3 Positionality

According to Massoud (2022), positionality is “the disclosure of how an author's racial, gender, class, or other self-identifications, experiences, and privileges influence research methods”, and hence also the outcome. As a white European researcher conducting research in an African country, it was crucial to recognize the complexities associated with the positionality of an ‘outsider’ engaging with a community that has a different cultural, social, and historical background. The colonial history of Zambia might have played an important role in how the local community perceived me, as the country had been colonised by the British until 1964 (Britannica, n.d.). This colonial view might also explain why mining was often seen as a sensitive topic of discussion, as the country's mineral rich soil was the key reason for the British to colonise the country (Gordan, 2012). Therefore, reflexivity, humility, and trust-building were crucial aspects while conducting this research.

2.3 Data analysis

2.3.1 Quantitative

After assigning values to all categorical variables (Appendix B), preparing the data for regression analysis, multilinear regressions have been conducted to analyse the relationship between the general quality of life score, satisfaction with the mining presence, mining impacts and housing prices, all in relation to the various demographic variables. Due to insufficient observations, the demographic variables 'years in mining' and 'position in the mining industry' have been excluded from the analyses. Moreover, to differentiate between individuals dependent on the mining industry and those who are not, the 'Mining dependency' variable was created. To measure the impact of employment, hereby focusing on the stress associated with looking for employment, the 'Retired' category was excluded. Furthermore, the 'relationship status' variable combined single, divorced, and widowed individuals to address low response rates without excluding them from the analysis. In order to measure the impact of mining proximity on the housing prices, the multi linear regression is performed with and without controlling for the geographical location, housing characteristics, and safety level, given that these factors appear to impact housing prices (Chen et al., 2022; Altenburg, 2017; Zhang, 2021; Tse-Wei Lee & Kuentai Chen, n.d.; Ceccato & Wilhelmsson, 2020). Moreover, the mining proximity in this regression has been based on the area of living (see Appendix B). Multi linear regressions have also been conducted to examine the relationship of the general quality of life score, satisfaction with the mine, and mining impacts, with the life domain satisfaction levels. A single linear regression has been performed to examine the relation between individuals' quality of life score and their satisfaction with the mining presence. Furthermore, the perceived mining impacts were analysed using a frequency table (based on Q.10-12), while mean mining presence satisfaction and quality of life scores were examined using a box plot. Lastly, the relationship between employment status/sector and the quality of life score, mining presence satisfaction, education level, and income, have been analysed using a ANOVA test.

Statistics

The analysis of this research has been conducted using the softwares SPSS and Python. It's crucial to emphasise that all regressions and mean comparisons assess the p-value, which determines the presence of a statistical relationship between an independent variable and the dependent variable. An alpha value (α) of 0.10 (10%) has been chosen as the minimum threshold for establishing statistical significance. A lower alpha value minimises the risk of a Type 1 error, where the null hypothesis (no relationship between two variables) is mistakenly rejected. With an α of 0.1, there is only a 10% probability of falsely rejecting the null hypothesis. Before the regressions had been conducted, all assumptions necessary for guaranteeing the validity and reliability of linear regressions - linearity,

homoscedasticity, independence of errors, normality of residuals, and independence of independent variables - have been examined (Bryman & Cramer, 2011). Furthermore, all multi linear regressions deal with missing values by excluding them from the analysis in a listwise manner. This resulted in various sample sizes in the regression. This method of deletion was chosen as the dataset composed of missing data points due the respondents freedom to leave questions unanswered. These missing observations have been assumed to be Missing Completely at Random (MCAR), therefore making listwise deletion an appropriate way of producing unbiased results (Van Buuren, 2018).

2.3.2 Qualitative

In order to analyse the interviews, they have first been transcribed and coded (Appendix L, Table.15) to highlight and exemplify the core themes. Additionally, a summary has been created for each interview (Appendix K) and focus group discussion (Appendix I), offering a concise and quick overview of the shared perspectives among the participants.

3. Results

3.1 Residents perception on mining influence

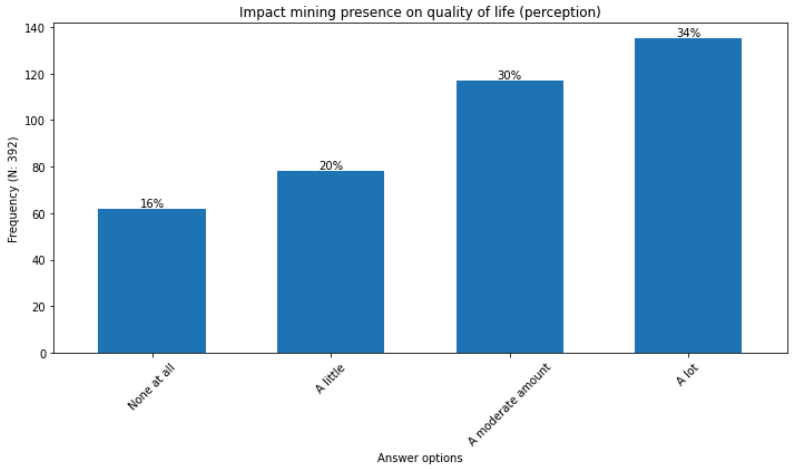


Fig.3| *Perceived impact of mining presence on quality of life.*

Among the respondents, 16% indicated that mining has no impact whatsoever on the quality of their life (Fig.3). An additional 20% reported only a minimal impact, while 30% of the respondents perceived a moderate influence. Notably, the largest segment (34%), expressed that the mining presence is affecting their quality of life a lot. In trying to understand how their quality of life is impacted by the mine, the perceived positive and negative impacts have been analysed.

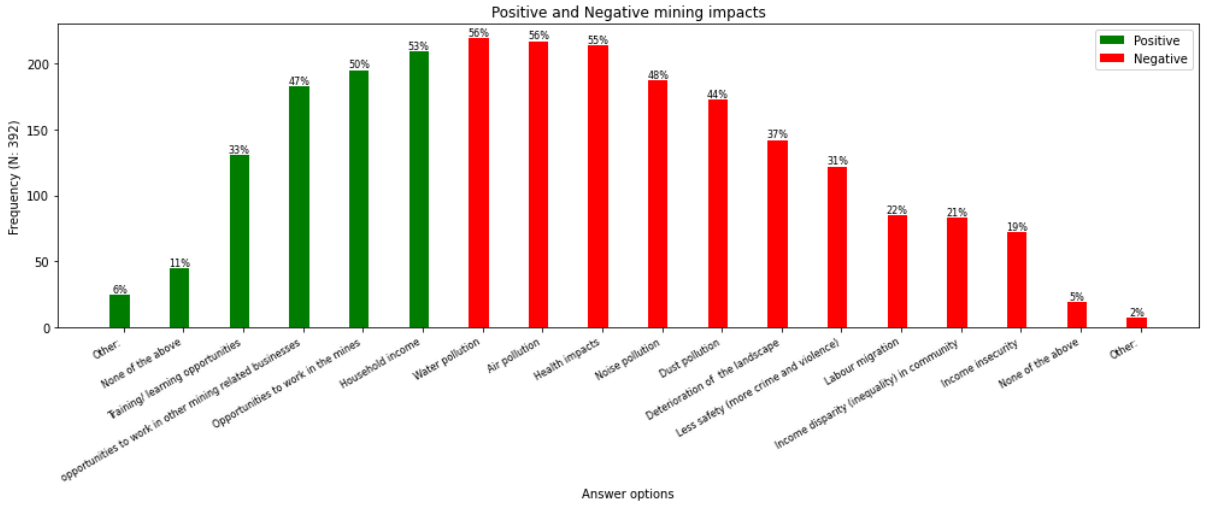


Fig.4| *Perceived mining impacts; % percentage of the total respondents.*
**Note: Survey question responses on mining impacts are visualised in Appendix E, Fig.18-19.*

3.1.1 Negative mining impacts

Pollution and health impacts

Regarding the negative impacts (Fig.4), some of the most significant concerns are water pollution (56%), air pollution (56%), noise pollution (48%), dust pollution (44%) and landscape degradation (37%). This is in line with the results from the interviews, as most participants (N.1-12) highlighted the problem of water contamination due to the leakage/dumping of chemicals into the water streams, which are ultimately used for drinking water purposes. This contamination does however not influence the seasonal farmers, as they rely on natural precipitation (N.3;4). Other participants (N.2;8;10) do refer to the negative effect of contaminated water on the farming of crops, as demonstrated by the police officer (N.8):

"Yes, farming. Because in a land where you are acidic, when you plant there, you will not have a good view of crops."

Fig.5| *Dust being cleaned from the road.*

Furthermore, all actors refer to the problem of air (and dust) pollution. When walking on the streets of Chingola, streets covered in dust are no exception. Despite the efforts of cleaning the dust from the streets (Fig.5), the healthcare actors (N.13;14) see the impact as many people suffer from occupational lung diseases like silicosis and respiratory tract infections due to the toxics in the dust and the poor air quality. It therefore does not come as a surprise that 55% of the survey respondents link the mining in Chingola with negative health impacts (Fig.4). The interviewed nurse (N.14) also experienced the impact of the mine with her father, as highlighted in the following quotation:

"I have my dad who was working for the mines, but unfortunately he left the mines because of the vertebra which is not okay. [...]. And on the non miners, non miners because of the smoke that we're inhaling, you have a lot of coughs, you have a lot of flu, you have a lot of respiratory tract infections because of the smoke."

Even among the remaining actors, people from all levels acknowledge the negative health impacts created by the mine. Besides these 'indirect' health impacts, the health care actors also highlight the

high number of injuries and casualties due to incidents within the mining sector. According to the CEO and his wife (N.11/12), the standard of safety measurements differentiate heavily between mining companies, with the Chinese holding the lowest safety and equipment standards. This view is widely shared during discussions with locals on the street.

Besides health impacts for humans, the non-human environment is also negatively affect by the mining activity, as highlighted by the police officer (N.8):

" [...] there's a stream which comes from the mine. The water there was acidic and it went straight down. And some people had the gut affected. [...]. Even living things in the right stream, for example, fish, they died."

And further highlighted by the unemployed tele-com specialist (N.2), which also highlights the displacement due to mining activity, a impact which is also shared in the survey responses (Appendix D, Table.11):

"But we have seen a contamination of our rivers, changes in bio, living things in waters. [....]. Trees have changed colours because of the sand. Even the lands we used to farm in nearby areas [...]. The soil has been mutated because of too much chemicals and because of the ore. [...]. So wherever you mine with exploration you find that communities have been displaced, animals have been displaced, have been pushed further."

He (N.2) also mentioned that rivers are becoming more shallow due to the intrusion of salt from the mining. According to the retired miner & seasonal farmer (N.3), the negative impacts have increased throughout the years:

"In the old days, they were not mining the way they are mining. It was only a very small scale, now the scale has been, it's gone up very high. And the methods they're using to extract the ore are not too good to human health. So back in the days when they used the old methods, there was less pollution and just more the benefits. But now it's much more pollution, much more contamination of water, especially the water bodies. The contamination is deep."

Despite the current lack of mining operations in Chingola, the participants (N.2;3) mention that the dust, air and water pollution seems to continue due to the loose sand in the open-pit mine, the rising water level in the mine, and the continuation of the smelter (ore from illegal miners and dumping sites).

Income inequality

When analysing the different neighbourhoods while walking, it is clear that there is a large difference between neighbourhoods in terms of housing quality and size. Out of the survey respondents, 21% linked income inequality as a negative mining induced impact (Fig.4). The hotel manager & former teacher (N.5) and the CEO of the mining trafficking company and his wife (N.11/12) attribute this disparity to the fact that there are relatively few positions with great incomes, leaving most people with a scarce source of income. According to hotel manager & former teacher (N.5), this disparity is getting bigger:

"And there's a huge gap between what I say, I call the have some, the have nots. Huge gap. The divide is getting bigger between the people who are in employment, the decent earning, and the people who are not employed."

However, the DC (N.7) does mention that the government is trying to minimise this gap by employing a restricted minimum wage.

Labour migration

Migration is not a prevalent topic in the interviews. Nonetheless, in casual street conversations, individuals frequently note the significant presence of labour migrants, predominantly from within the country, as well as a considerable number from the Democratic Republic of Congo. Its presence can also be seen in the fact that 22% of the survey respondents (Fig.4) selected it as a mining-induced negative impact.

Explosions

Fig.6| *Cracks in a house near the mine.*

Another common negative problem, which only came out of the qualitative analysis, is housing damage due to the mining explosions, primarily to houses in close proximity to the mining site (Fig.6). In general, houses in close proximity to the mine are in poor conditions (Appendix G, Table.14). Besides cracks, these explosions also come with a lot of sound due to the use of dynamite and heavy machinery, which are running 24/7 (N.3). The impact of these explosions is emphasised by

the retired miner & farmer (N.3), who even refers to instances where they were told to go out a safe distance until the blasting was done.

Dependency (income insecurity & safety)

In general, all interviewees indicate that their standard of living is, in one way or another, influenced by and dependent on the success of mining in Chingola. Even the actors that were initially perceived as non-mining related actors (N.1;2;8;9;11/12) highlight this dependency on the mine, as demonstrated by a hotel manager, which reflects on the impact of the temporary halt (N.1):

"It has really been bad because again the mines have contractors and these contractors have not been paid. Those contractors are our customers [...]. So if most of the contractors are not paid, meaning that there's no cash flow, there's no money to spend. [...] I have not paid salaries from last year in December because of that impact [...]."

The unemployed telecommunications specialist (N.2) even emphasised the direct influence of the London Stock Exchange on the quality of life in Chingola. He highlighted that when copper prices rise, Chingola thrives, but that a sudden decline can lead to issues such as delayed salaries. The past months showcase the disastrous impacts a lack of mining operations can have on the quality of life of people in the Chingola community, as since the mine's closure, there has been a notable surge in criminal activity (N.1-12). This is attributed to the prolonged non-payment of many working individuals and overall unemployment, leading them to seek alternative (often illicit) means of income generation. This is highlighted by the police officer (N.8):

"[...] we have now the high number of criminals. Those who are working in the mine [...] the only source of income they have is the mine. So now they are out there, the only way they can sustain themselves is by stealing."

However, even with the mine fully operational, there remains the issue of an illegal mining circuit (N.2;6;7;10;11/12). The continuous presence of criminal activities and job uncertainty is in line with the fact that a substantial part (31%) of the survey respondents indicate safety concerns and income insecurity (19%) as negative mining-induced problems (Fig.4). Besides criminal activity, there has been a rise in prostitution (N.2;9), substance use (N.2;6;9) and general violence (N.7;9). Therefore, it is common to see teenagers on the streets during the day, often under the influence of alcohol, asking for jobs and money, and, in the case of females, offering prostitutional services. (Appendix G, Table.14).

According to the unemployed tele-communication specialist (N.2), the current stoppage also sheds light on another problem, which is the fact that there is no safety net when people get unemployed. Meaning that many people will not be able to pay for basic services like water and electricity, which could have dangerous consequences:

"[...] there has been also a case of typhoon or diarrea diseases because we have to pay for the water for instance. So if you lose the job [...] the utility companies, they come and disconnect your water. [...] if your water is disconnected, how are you going to flush water? [...]. How are you going to practise hygiene per se? So we danger ourselves." - N.2

In short, this dependency highlights the problem of income insecurity, which leads to safety and health concerns.

Besides causing problems for the current generation of adults, unemployment also affects the next generation, as college students often have to drop out due to their parents' loss of income and inability to pay school fees (N.2).

Housing price degradation

The impact of mining proximity on housing values (rental prices) shows that neighbourhoods farther from the mine have significantly higher rental prices (Table.1). However, when controlling for other determinants of housing value, mining proximity is no longer significant, indicating that the mine itself does not directly influence housing values. Instead, the number of bedrooms and bathrooms significantly impact housing values. In these higher-value homes farther from the mine, older individuals, those with higher education levels, and those employed in the mining or related sectors predominantly reside, as evidenced by the significant correlations between housing value and age, education, and mining dependency.

Table.1| *Influence mining proximity on housing prices; Confidence interval=*90%;**95%;***99%; Grey: significant variable.*

		Unstandardized Coefficient		*Standardised Coefficients*	*Significance*
Dependent variable	**Independent variable(s)**	*B*	*Std. Error*	*Beta*	*P-Value*
Renting price (not controlled) (N=140)	(Constant)	759.046	357.826		0.036
	Mining proximity	537.734	185.667	0.239	0.004**
Renting price (controlled) (N=125)	(Constant)	-2940.310	1238.069		0.019
	Mining proximity	288.555	206.106	0.125	0.164
	Safety	-61.972	128.062	-0.041	0.629
	Dist. Hospital	-116.941	126.716	-0.088	0.358
	Dist. Bus station	269.381	169.274	0.164	0.114
	Dist. Train station	181.336	116.183	0.128	0.121
	Dist. Main road	-125.584	157.356	-0.080	0.426
	Number of bedrooms	415.171	188.375	0.204	0.030
	Number of bathrooms	840.837	277.162	0.292	0.003
	Housing material	219.781	253.709	0.076	0.388
	Electricity access	339.967	873.716	0.033	0.698
Renting price (demographics) (N=104)	(Constant)	-4030.056	1137.823		<0.001
	Sex	222.158	426.005	0.052	0.603
	Age	71.785	23.297	0.330	0.003
	Relationship status	42.347	464.572	0.010	0.928
	Household size	27.879	79.344	0.035	0.726
	Education level	568.143	227.429	0.245	0.014
	Employment status	-250.794	428.227	-0.061	0.559
	Mining dependency	857.302	405.984	0.191	0.037

Not controlled/ Controlled/ Demographics
**R= 0.239/ 0.531/ 0.485*
**R Square= 0.057/ 0.282/ 0.235*
**Adjusted R Square= 0.050/ 0.219/ 0.180*

Remaining negative impacts

Other negative impacts linked to the mining presence are financial strains for workers, governmental revenue losses from tax evasion, and the creation of strategic tensions to secure favourable policies (Appendix D, Table.11).

3.1.2 Positive mining impacts

Economic prosperity

The most significant positive impacts linked to the mining presence include household income (53%), opportunities to work in the mine (50%) and opportunities to work in mining related businesses (47%). This is in line with the qualitative data, as all actors (which have been asked) indicate the mine's importance to the economic prosperity of the Chingola community through direct and indirect employment and overall money circulation. It's economic importance can also be subtracted from the impact of the current lack of mining activity, as highlighted by KCM employee (N.6):

"So, since we rely so much on the mine, but the mine is not fully in operation, [...] it becomes tough for the people. It becomes tough for the businesses around the area. It becomes very tough. Very, very tough. [...]. It employs a lot of people. Now, since the giant mine is not in operation, it can't employ. And the business around the area has been affected, like, greatly affected. [...] So, there is literally not much money in circulation [...]. It can't pay the suppliers, because they aren't doing anything. So, the money that suppliers need to use in circulation, or needs to use around the area, it's not there."

Facilities

Fig.7| *School, hospital and football training ground funded by KCM.*

The mining company has also invested in community facilities. A prominent sign (Fig.7) stands proudly in front of the secondary school, hospital, and football training ground, showcasing the company's 'commitment' to enhancing the local infrastructure. These investments fall within the CSR embraced by the mine. CSR also came out of the survey results as a positive mining-induced impact (Appendix D, Table.11). However, as highlighted by the CEO (N.11/12), the degree of these investments heavily relies on the success and ambitions of the mine itself. Furthermore, the mine supports the local football team (The Nchanga Rangers F.C.), which has been performing considerably worse since CSR initiatives declined (Appendix G, Table.14). The CEO and his wife (N.11/12) further contends that illegal mining and state-owned mining entities contribute significantly less to social responsibility due to their lack of profitability.

Fig.8| *Clear distinction in quality between the main roads (left) and side roads (right).*

Although infrastructure, which is either directly or indirectly paid by the mines through CSR or tax revenues, is well maintained on the main roads (Fig.8), observations emphasise the lack of road infrastructure development beyond the main roads (Fig.8).

Training/learning opportunities

33% of the survey respondents also mentioned that the mining sector creates training/learning opportunities for the people of Chingola (Fig. 4), which the DC (N.7) elaborates on:

"They were doing a lot of work to help the community [...], also sponsorship for students from the community. [...]. And then the company used to sponsor them to go into universities and colleges. And some of them were being sent outside the country for training. And then when they come back, they have automatic employment because they went as students, sponsored by the company."

3.1.3 Awareness among the young generation

The young students were well aware of the diverse range of positive and negative impacts related to mining. Mentioning impacts as acid rain, water contamination, air- and noise pollution, employment, income, supporting facilities (sporting, health, free education), and providing cooking supplies. They did however emphasise the positive impacts, as employment, income, and education is the main concern for the future of these children. They were also expressing their sense of dependency on the mine, but displayed no ambition to diversify, as the majority of the class wants to work for the mining sector after finishing school. Most of the students also indicated to have seen a negative impact since the mine is not fully operational, referring to a lack of income, increase in crime, and an uncertain future.

3.1.4 Contrasting perspectives

Interestingly, there's a noticeable divide in perceptions between government/mining officials, including the DC (N.7), the Mayor (N.9), and the KCM employee (N.6), and the local population. These officials present a narrative that is markedly optimistic about the mining industry's impact on the community, as they emphasise the sector's vital role in generating employment, fostering economic growth, and enhancing the community's overall standard of living over the negative mining related impacts.

3.2 Mining impacts distribution in the community

3.2.1 Distribution negative mining impacts

Fig.9| *People living in close proximity to the copper smelter.*

When looking at the distribution of the negative impacts (Table.2), residence proximity to the mine shows a negative correlation with water- and air pollution, indicating that individuals living closer to the mine report poorer water- and air quality. This is supported by the observations (Appendix G, Table 15), as the proximity to the actual mine/smelter is minimal in some areas (Fig.9). These areas often comprise smaller, low-quality houses. Furthermore, a great amount of people cannot afford clean bottled water (N2;5), a leakage in the waterstream will therefore have a bigger impact on the poorer part of the population. Additionally, this group is less able to pay for medical assistance when needed. Furthermore, age is significantly correlated with poorer self-reported health, a higher perception of income disparity within the neighbourhood, and a greater indication of land degradation in the Chingola area. Moreover, higher levels of education are associated with less noise- and dust pollution, but also with a heightened sense of unsafety and income disparity within the neighbourhood. Additionally, employment status is significantly correlated to air pollution, with employed individuals reporting to have better air quality compared to the unemployed. Furthermore, females indicate fewer labour migrants in the area, while those living in larger households report more labour migrants. Lastly, individuals in relationships express less income insecurity than those who are not (or are widowed).

Table.2| *Demographic distribution of the negative mining impacts; Unstandardized Coefficient (Coefficients Standard Error);Confidence interval=*90%,**95%,***99%; Grey: significant variable.*

	Dependent variable(s)									
Independent variable(s)	Water pollution (N=277)	Air pollution (N=276)	Health (N=240)	Noise pollution (N=275)	Dust pollution (N=275)	Landscape degradation (N=274)	Safety (N=258)	Labour migrants (N=258)	Income disparity (N=257)	Income insecurity (N=268)
(Constant)	3.107 *** (0.400)	3.132*** (0.331)	103.227 *** (8.034)	2.498*** (0.345)	2.428*** (0.320)	2.613*** (0.252)	2.693*** (0.443)	2.150*** (0.291)	1.872*** (0.322)	2.204*** (0.287)
Area of residence	-0.196** (0.081)	-0.109* (0.067)	-1.940 (1.568)	-0.100 (0.070)	-0.007 (0.065)	0.005 (0.051)	-0.106 (0.089)	-0.066 (0.058)	-0.036 (0.064)	-0.003 (0.058)
Sex	-0.070 (0.146)	-0.027 (0.121)	-3.371 (2.869)	-0.019 (0.126)	0.039 (0.117)	-0.127 (0.092)	-0.062 (0.159)	-0.208** (0.104)	0.081 (0.116)	-0.041 (0.105)
Age	0.006 (0.008)	0.005 (0.007)	-.397* (0.154)	0.002 (0.007)	-0.001 (0.006)	0.017*** (0.005)	-0.006 (0.009)	-0.004 (0.006)	0.012* (0.006)	-0.001 (0.006)
Relationship status	0.076 (0.147)	0.182 (0.122)	-.070 (2.964)	-0.004 (0.127)	0.057 (0.119)	-0.061 (0.093)	0.199 (0.163)	0.032 (0.107)	-0.038 (0.119)	-0.271** (0.107)
Household size	0.006 (0.029)	-0.001 (0.024)	0.146 (0.570)	0.008 (0.025)	0.043* (0.023)	0.005 (0.018)	-0.033 (0.032)	0.036* (0.021)	-0.023 (0.023)	0.008 (0.021)
Education level	0.032 (0.078)	-0.070 (0.064)	-1.071 (1.531)	-0.111* (0.067)	-0.126** (0.062)	0.012 (0.049)	0.158* (0.085)	-0.003 (0.056)	0.203*** (0.062)	0.081 (0.056)
Employment status	0.082 (0.150)	-0.207* (0.124)	-.852 (2.979)	0.090 (0.130)	0.056 (0.121)	-0.083 (0.095)	-0.090 (0.165)	0.131 (0.108)	0.059 (0.120)	0.118 (0.108)
Mining dependency	0.184 (0.144)	-0.040 (0.120)	-.058 (2.824)	0.012 (0.125)	-0.089 (0.116)	-0.018 (0.091)	-0.050 (0.157)	0.014 (0.103)	-0.141 (0.114)	0.053 (0.103)

3.2.2 Distribution positive mining impacts

When examining the positive impacts (Table.3), females notably experience fewer mining- and mining related job opportunities compared to males. This is supported by observations which suggest that the mining workforce is predominantly male. However, women seem to be dominating the hospitality and cleaning business (Appendix G, Table.14). Regarding monthly household income, age and education level show a positive correlation, indicating that older individuals and those with higher levels of education tend to have higher incomes compared to younger and less educated individuals. Additionally, employed individuals report more mining- and mining related job opportunities as well as training/learning opportunities. Furthermore, individuals in relationships indicate fewer mining related job and training/learning opportunities than those who are not in relationships. Household size shows the opposite trend, with an increase significantly correlated with more mining-related job and training/learning opportunities.

Table.3| *Demographic distribution of the positive mining impacts; Unstandardized Coefficient (Coefficients Standard Error);Confidence interval=*90%,**95%,***99%; Grey: significant variable.*

	Dependent variable(s)			
Independent variable(s)	Income (N=134)	Mining job opportunities (N=268)	Mining related job opportunities (N=266)	Training/ learning opportunities (N=265)
(Constant)	-30,314.555** (11,357.323)	1.604*** (0.347)	1.991*** (0.339)	2.382*** (0.404)
Area of residence	855.413 (2,366.628)	-0.040 (0.070)	-0.067 (0.068)	-0.082 (0.082)
Sex	-3,277.427 (4,482.961)	-0.324** (0.126)	-0.308** (0.124)	-0.144 (0.148)
Age	776.793** (242.587)	0.001 (0.007)	0.003 (0.007)	-0.006 (0.008)
Relationship status	-6,098.635 (4,493.580)	-0.208 (0.128)	-0.249** (0.126)	-0.355** (0.151)
Household size	-1,108.024 (824.753)	0.035 (0.025)	0.055** (0.025)	0.049* (0.029)
Education level	4,891.405** (2,196.839)	0.019 (0.067)	-0.030 (0.066)	-0.064 (0.079)
Employment status	-247.951 (4,377.637)	0.511*** (0.130)	0.290** (0.127)	0.455** (0.152)
Mining dependency	2,335.855 (4,069.592)	-0.031 (0.123)	-0.018 (0.121)	-0.041 (0.144)

3.2.3 The importance of education

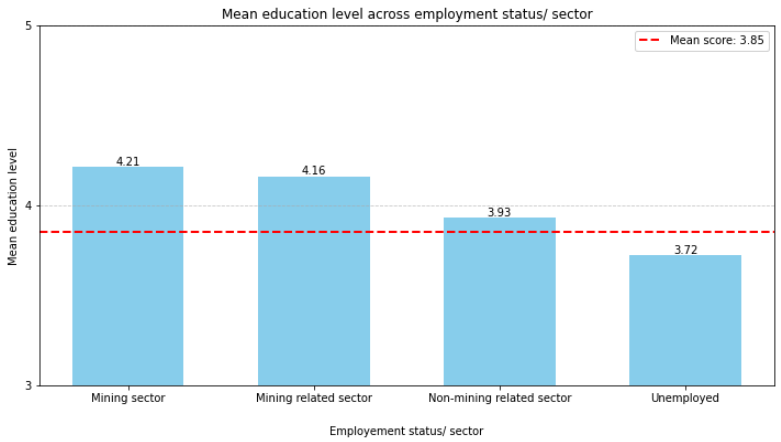


Fig.10| *Mean education level in terms of employment status/sector; N=76-25-82-187; P-value = 0.001.*

Given that employment and education emerge as significant predictors for some of the positive (Table.3) and negative (Table.2) impacts related to mining, it's important to explore the relationship between these variables. Individuals employed in the mining sector are the most educated, with an average score of 4.21 (Fig.10), closely followed by those working in mining related sectors (4.16). Conversely, individuals employed in non-mining related sectors and those who are unemployed tend to have lower levels of education, with average scores of 3.93 and 3.72, respectively.

3.3 Mining satisfaction and its relation with quality of life

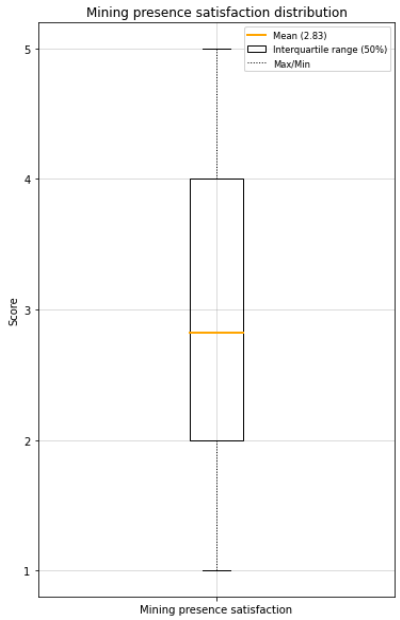


Fig.11| *Mining presence satisfaction distribution; N=350.*

The satisfaction with the mining presence is, with an average score of 2.83, slightly below the neutral median mark of 3 (Fig.11), indicating a lean towards satisfaction rather than dissatisfaction with the mining presence. The distribution is primarily left-skewed, as evidenced by the mean's position below the median within the box plot. However, the presence of a longer upper tail suggests notable exceptions. While most observations are clustered towards the lower end of the interquartile range (indicating a right-skewed distribution), some respondents express significantly higher levels of dissatisfaction, slightly extending the upper tail.

Fig.12| *Relation mining presence satisfaction score and the quality of life score.*

In general, mining presence satisfaction has been found to be an important predictor for the quality of life score, as indicated by the low p-value (0.002) (Fig.12). Additionally, the downward slope of -5.81 indicates that as satisfaction with the mining presence diminishes, there is a corresponding decrease in quality of life scores. It is therefore crucial to understand the factors driving this satisfaction level.

Mining presence satisfaction has found to be significantly influenced by both environmental and geographical satisfaction (Table.4). The positive coefficients indicate that as satisfaction with these two domains decreases, individuals are generally less satisfied with the mining presence. Geographical satisfaction is significantly lower for respondents that live closer to the mine (Table.5). Furthermore, environmental satisfaction is significantly lower for respondents with higher levels of water-, air-, and noise pollution, and landscape degradation (Table.5).

Table.4| *Influence quality of life domain satisfaction on the mining presence satisfaction; Controlled for demographics; Confidence interval=*90%,**95%,***99%; Grey: significant variable.*

		Unstandardized Coefficient		*Standardised Coefficients*	*Significance*
Dependent variable	**Independent variable(s)**	*B*	*Std. Error*	*Beta*	*P-Value*
Mining presence satisfaction (N=234)	(Constant)	0.357	0.525		0.497
	Environmental satisfaction	0.344	0.075	0.325	<0.001***
	Economic satisfaction	0.010	0.077	0.009	0.899
	Social satisfaction	0.090	0.090	0.075	0.314
	Geographical satisfaction	0.132	0.071	0.125	0.064*
	Personal satisfaction	0.097	0.073	0.088	0.184
	Housing satisfaction	0.068	0.068	0.067	0.324

**R= 0.562*
**R Square= 0.317*
**Adjusted R Square= 0.273*

Table.5| *Influence of satisfaction indicators on the domain satisfaction levels; Controlled for demographics; Unstandardized Coefficient (Coefficients Standard Error); Confidence interval=*90%,**95%,***99%; Grey: significant variable; Red: linked NMI; Green: linked PMI; Blue: MRI; IV's = Independent variables, DV's = Dependent variables.*

	Quality of life domain indicators (IV's)				
Quality of life domains (DV's)	Water pollution	Air pollution	Dust pollution	Noise pollution	Landscape degradation
Environmental satisfaction (N=287)	0.356*** (0.061)	0.200** (0.082)	0.080 (0.089)	0.147* (0.082)	0.266** (0.091)
	Income	Mining job opportunities	Mining related job opportunities	Training/ learning opportunities	Income insecurity
Economic satisfaction (N=140)	-1.364E-5*** (0.000)	0.048 (0.119)	-0.418*** (0.123)	0.004 (0.101)	0.340** (0.123)
	Relationship quality	Community participation	Safety concerns	Labour migration	Income disparity
Social satisfaction (N=143)	-0.125*** (0.029)	0.117 (0.077)	0.232** (0.074)	0.134 (0.115)	-0.093 (0.093)
	Hospital proximity	Bus station proximity	Train station proximity	Main road proximity	Mining area proximity
Geographical satisfaction (N=238)	0.349*** (0.064)	-0.039 (0.076)	0.019** (0.053)	0.067 (0.074)	-0.097* (0.060)
	Sleep	Self-esteem	Physical activity	Personal time	General health
Personal satisfaction (N=246)	-0.093 (0.094)	-0.102*** (0.029)	-0.008 (0.031)	0.077 (0.049)	-0.027*** (0.003)
	Number bedrooms	Number bathrooms	Housing material	Housing price (rent)	Electricity supply
Housing satisfaction (N=108)	-0.367** (0.160)	-0.266 (0.189)	-0.100 (0.175)	-4.759E-5 (0.000)	-1.578** (0.645)

Fig.13| *Mean mining presence satisfaction in terms of employment status/sector; N=71-169-70-25; P-value = 0.080.*

When examining the influence of demographics on the mining presence satisfaction level, mining dependency emerges as the sole significant predictor (Table.6). The downward slope of -0.371 illustrates that individuals employed in the mining (related) sector tend to exhibit higher satisfaction with the mining presence compared to those who are not employed in this sector (or are currently unemployed). It is hereby crucial to note the lack of distinction between those employed in non-mining related sectors (2.9) and those who are unemployed (2.9) (Fig.13), as this highlights that satisfaction with the mining presence is not solely influenced by job creation - which could explain the lack of significance for economic satisfaction (Table.4).

Table.6| *Demographic distribution of the mining presence satisfaction score;Confidence interval= *90%,**95%,***99%; Grey: significant variable.*

		Unstandardized Coefficient		*Standardised Coefficients*	*Significance*
Dependent variable	**Independent variable(s)**	*B*	*Std. Error*	*Beta*	*P-Value*
Mining presence satisfaction (N=266)	(Constant)	2.922	0.479		<0.001
	Area of residence	0.030	0.098	0.020	0.762
	Sex	0.118	0.176	0.046	0.502
	Age	0.014	0.010	0.111	0.139
	Relationship status	0.156	0.180	0.062	0.387
	Household size	0.005	0.036	0.010	0.883
	Education level	-0.067	0.094	-.046	0.474
	Employment status	-0.175	0.180	-.070	0.333
	Mining dependency	-0.371	0.171	-.134	0.031**

**R= 0.185*
**R Square= 0.034*
**Adjusted R Square= 0.004*

3.4 Life satisfaction and its relation with quality of life

The importance of economic satisfaction does however comes forth when examining the relationship between the quality of life domains and the quality of life score (Table.7), as besides environmental and geographical satisfaction (which also were significantly correlated with mining presence satisfaction - Table.4), economic satisfaction exhibits a significant correlation as well (the largest). When satisfaction with these three domains decreases, there is a significant decrease in overall quality of life. Moreover, economic satisfaction is positively influenced by mining related job opportunities and income, and negatively influenced by income insecurity (Table.5).

The finding that economic satisfaction has the most prominent impact on quality of life is something that fits the context on the ground really well, as a big proportion of the people living in Chingola are continuously looking for ways to generate income in order to survive. As highlighted by the CEO and his wife (N.11/12), the Maslov hierarchy of needs could be an explanation for this, as peoples first priority is survival. Therefore, they (N.11/12) think employment is the most important aspect influencing the quality of life in Chingola. After people are assured of income, they think that people will start to worry more, and take actions against the negative impacts of the mine.

Although social satisfaction does not appear to be significantly correlated with the overall quality of life score (Table 4), observations indicate that social life is important for the people in Chingola. However, as mentioned by the mining supplier & farmer (N.4), the ability to participate in social activities is predominantly influenced by income, which again, links back to economic satisfaction.

Table.7| *Influence quality of life domain satisfaction on quality of life score; Controlled for demographics; Confidence interval =*90%,**95%,***99%; Grey: significant variable.*

		Unstandardized Coefficient		*Standardised Coefficients*	*Significance*
Dependent variable	**Independent variable(s)**	*B*	*Std. Error*	*Beta*	*P-Value*
Quality of life (N=251)	(Constant)	87.539	9.144		<0.001
	Environmental satisfaction	-3.940	1.342	-0.199	0.004**
	Economic satisfaction	-7.173	1.368	-0.351	<0.001***
	Social satisfaction	-1.178	1.589	-0.051	0.459
	Geographical satisfaction	-2.343	1.272	-0.116	0.067*
	Personal satisfaction	0.094	1.264	0.005	0.941
	Housing satisfaction	0.565	1.216	0.029	0.643

**R= 0.595*
**R Square= 0.354*
**Adjusted R Square= 0.315*

The significant role of job opportunities can also be seen when examining the influence of demographics on the quality of life score (Table.8), as employment status emerges as the only significant predictor. Individuals who are employed report an average quality of life score that is 7.7% higher than those who are unemployed. As the mine is (directly and indirectly) responsible for most of the job creation in Chingola (see 3.1.2), the mining operations are (solely based employment) significantly important for an increase in quality of life.

Table.8| *Demographic influence on the Quality of life score; Confidence interval=*90%;**95%;***99%; Grey: significant variable.*

		Unstandardized Coefficient		*Standardised Coefficients*	*Significance*
Dependent variable	**Independent variable(s)**	*B*	*Std. Error*	*Beta*	*P-Value*
Quality of life (N=283)	(Constant)	36.466	8.532		<0.001
	Area of residence	-1.613	1.748	-0.057	0.357
	Sex	1.862	3.139	0.039	0.554
	Age	0.168	0.173	0.070	0.333
	Relationship status	0.543	3.181	0.012	0.865
	Household size	0.386	0.630	0.038	0.540
	Education level	1.307	1.645	0.049	0.428
	Employment status	7.666	3.231	0.166	0.018**
	Mining dependency	1.323	3.088	0.025	0.669

**R= 0.215*
**R Square= 0.046*
**Adjusted R Square= 0.018*

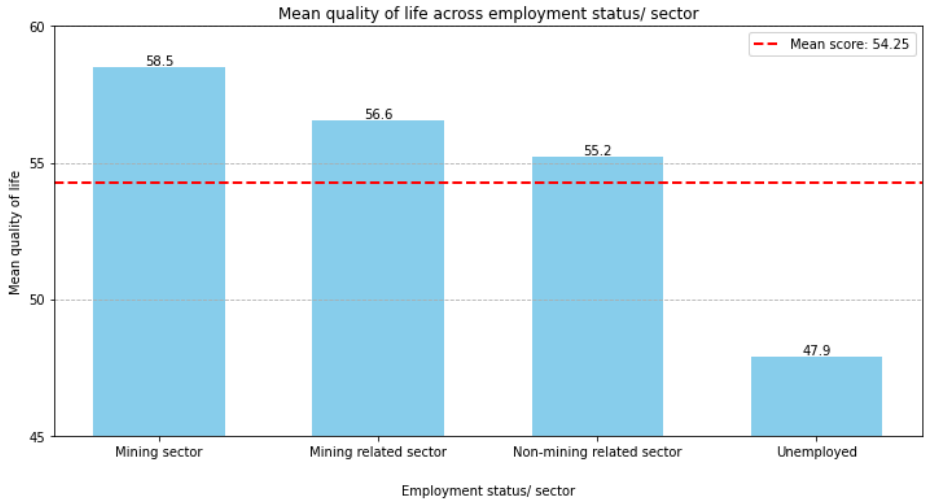


Fig.14| *Mean quality of life scores in terms of employment status/sector; N=76-25-84-187; P-value = 0.005.*

Apart from the significant discrepancy in the quality of life concerning employment status (Table.8), there's also a notable contrast between individuals employed in the mining sector and those who aren't (Fig.14). Those involved in the mining sector report the highest average quality of life scores (58.5),

notably exceeding the overall average (54.25). Furthermore, both mining-related and non-mining related workers also exhibit scores slightly above average, with those working in the mining related sector (56.6) still exceeding those who work in non-mining related sectors (55.2).

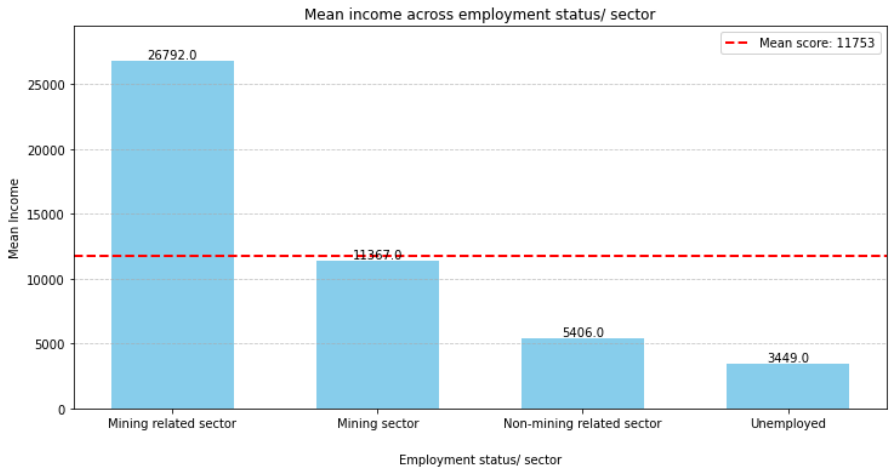


Fig.15| *Mean income in terms of employment status/ sector; N=13-37-42-69; P-value = 0.005.*

Knowing that income is a significant predictor of economic satisfaction (Table.5), which is positively correlated with the general quality of life score (Table.7). The difference in quality of life between non-mining related workers and mining (related) workers can potentially be explained by looking at the difference in income, as those working in the mining (related) sectors earn significantly more than those who work in non-mining related sectors (Fig.15).

The difference in quality of life between the employed and unemployed is also evident from participatory observations (Appendix G, Table 14), as elderly people and children often appear happy and open to interaction, while the working-age group frequently express angry faces and gestures, and often beg for food, water, and jobs. This is primarily attributed to the current lack of mining operations (N.1-12). According to the retired miner & farmer (N.3) and hotel manager & former teacher (N.5), both past retirement age, the economic, social, and environmental conditions were better in the past, leading to less stress for their generation. Additionally, employment is not a stress factor to them. Similarly, despite uncertainties in the mining situation, the young students generally look to the future with optimism and aspirations (Appendix I).

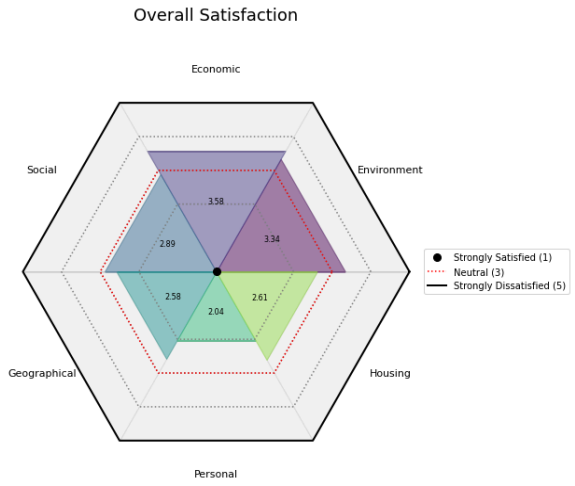


Fig.16| *Mean satisfaction score per domain.*

The significant negative impact of a decrease in environmental and economic satisfaction on the quality of life score (Table.7) is alarming, as these are the only two domains with average scores falling into the 'dissatisfaction' range (Fig.16).

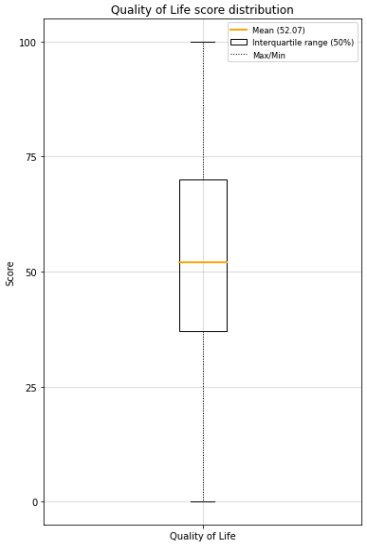


Fig.17| *Quality of life score distribution; N=392.*

Fortunately, the mean quality of life score still falls, with an average of 52.07 (Fig.17), slightly more towards satisfaction. Most (50%) of the respondents indicate a quality of life between 37 and 70, with outliers giving their quality of life a score of 0 and 100. The score is right-skewed, as evident by the mean being higher than the median (50) and the longer upper tail of the interquartile range, which represents the middle 50% of the data. This skewness indicates a dense clustering of observations towards the lower end of the box plot, while observations at the higher values are more spread out.

A continuation of the lack of mining activities - increase of income insecurity, decrease in job opportunities, and a continuation of some of the environmental pollution (see 3.1.1) - could have a negative impact on the quality of life, potentially pushing the score to dissatisfaction.

3.5 Social responsible and sustainable mining

3.5.1 Responsibility

Changes over time

In order to understand the problems associated with the mining current situation, it's important to realise the changes that have led to the status quo. According to participants 1-7, 9, and 10, the mining companies are investing less money and resources (CSR) in the community than before. According to the hotel manager & former teacher (N.5) and the CEO and his wife (N.11/12), this decline can be partly attributed to the historical practice of Western companies bringing their own workforce, which encouraged investment in the local community. However, the decline of CSR this decade could also have been caused by political corruption, as referred to by the KCM employee (N.6):

"Because I believe the previous government, they would come to them and ask maybe for money. [...] And then they have been there to say, the money that we have is for the corporate social responsibility. Now the previous government would say, no, no, just give the government. We want to do ABCD."

He (N.6) also mentioned that before the decline, Vedanta Resources invested significantly more in the community, such as providing free mosquito nets. Hotel manager & former teacher (N.5) highlighted the importance of a swimming pool. She also mentioned how much joy these sporting facilities brought to the community. After the CSR declined, there was not enough money to sponsor the local community to participate in these activities, eventually causing most facilities to shut down. Even the facilities that are still being used are, according to both hotel managers (N.1;5) and the KCM employee (N.6), not well maintained.

During the recent negotiations between the government of Zambia and Vedanta Resources, they have promised the government to allocated 20 million dollars annually to the CSR of the Chingola community (N.6;10), according the the KCM employee (N.6), they would like to use that money for the following:

"[...] they want to revamp those facilities [...] they want to revamp those things, rugby, swimming pool, tennis, bowling, all those games that will keep these guys, maybe youngsters, maybe students, [..] will keep them busy."

The Mayor of Chingola (N.10) has stated that if Vedanta Resources fails to fulfil its commitment, it will be "shown the door."

Compensation

This money is heavily needed as the local community expresses concerns over the challenge of receiving adequate support and compensation for the negative mining impacts. As highlighted by the mining supplier & farmer (N.4):

"[...] those that are close to the open pits. They get cracks. Huge cracks because of the impact of mining and explosives. [..] I haven't seen anybody being compensated because their house got cracked. In fact, they don't even know where to go."

She (N.4) also mentions that many affected individuals often give up on seeking compensation due to their grievances being overlooked by the local government. Consequently, they no longer put forth the effort to claim what they're owed. Additionally, she points out that a significant number of people are unsure of where to turn for assistance. In her own experience, she has only been compensated once for water contamination, despite it being a recurring issue. Notably, that one time was with the assistance of a Western NGO.

A different sound comes from the governmental (N.7;10) and mining (N.6) officials, as they assert that the negative consequences associated with mining activities, such as environmental degradation and health issues, are systematically addressed through compensation mechanisms and community support initiatives (N.7). As demonstrated by the DC (N.7):

"People come to complain to me, then I engage other institutions that the workers are complaining about. And I invite them to this office, we look at the issues at hand and lobby for the community. And I can say the response has been very, very positive."

The lack of financial and social support in the compensation process could, according to the CEO (N.11/12), be explained through the role of corruption in obstructing a fair and accurate compensation process.

In terms of compensation for medical complaints, the health actors (N.13;14) indicate that the mining companies do take their responsibility, but only in regards to their own employees. Furthermore, out of the two hospitals in Chingola, only is financed by the mining company (KCM). This hospital treats their own employees and is more advanced compared to the 'local' hospital (Appendix G, Table.14). Thus, mine employees receive much better care, despite no significant difference in health and pollution between them and non-mining employees has been found (Table 4). Therefore, more money must be invested into the health of non-mining employees who are negatively affected by mining.

However, this is challenging as the DC (N.7) denies that non-mining employees suffer from mining-related complaints.

Compensation for health damage due to mining activity is thus an issue that must be addressed in order to mine in a responsible manner. According to the doctor (N.13) and nurse (N.14), this is already much better compared to the past. However, they still would like the mining companies to invest more into the building of new hospitals, the modernization of existing ones, and the improvement of safety standards and guidelines within the mines. Furthermore, extra precautions and follow-up measurements must be implemented in areas closer to the mining activity, as these areas are significantly more affected in terms of water and air pollution (Table.2).

Recovery of the mine

When asked about the time the city will take to recover if the mine starts running again, there seems to be (again) contrasting views. Some, like the KCM employee (N.6), the DC (N.7), and the Mayor (N.10), are optimistic, believing that the infusion of jobs and capital from the mine's operations could spark a rapid turnaround for Chingola's economy and social livability. They speak of months, not years, for the community to see significant improvements. On the contrary, individuals like the retired miner & farmer (N.3) and the hotel manager (N.1) are more cautious in their outlook. They acknowledge the potential for improvement but stress that the damage from the mine's closure, ranging from increased crime to environmental degradation, has been profound and will require more time and investments to heal. The retired miner & farmer (N.3) further highlights that the longer the mine is left without activity, the harder it will be to revive it.

3.5.2 Sustainability

Mining already happens in quite a sustainable manner when looking at the re-use of mining waste, as the dumping sites from the past have been allocated to small-business entrepreneurs to extract ore themselves (N.2;6;7). They often bring it to the Chinese, as through the use of new technologies, the Chinese can extract minerals from ore that was previously seen as waste (N.6). Despite the sustainable benefit these dumping sites create, there are substantial problems associated with them (N.2;6;7;10;11/12), such as illegal mining and lower safety measurements, leading to more accidents. Therefore, to encourage the sustainability benefit of reusing dump sites, these problems must be addressed first. Moreover, as noted in section 3.1.1, the mining in Chingola has detrimental impacts on humans and the natural environment. Therefore, achieving sustainable mining practices necessitates a substantial investment in mitigating these impacts.

Another critical aspect of sustainability pertains to mining employment, as the modernization of the industry has led to a decline in job opportunities (N.11/12), which is the most important benefit of the mining sector (see. 3.1.2). Furthermore this trend of modernization is expected to continue (N.11/12), posing a threat to job prospects for future generations. Diversification is therefore more of a necessity than a choice (N.2;11/12). According to the Mayor (N.10), Chingola is already actively investing in diversification, with a primary focus on the agricultural sector. This transition is already evident, according to the DC (N.7).

In general, all participants only want the mining to start becoming fully operational again if it's done in a responsible and sustainable way, for both the human and the non-human world, and for the current and the future generation. Hence, it is imperative for the government to listen to the voices of the people, who, despite facing hardships, maintain a notable sense of optimism:

"This is our land. This is our order. Together we can sustainably use and utilise the resources that we have been given by the author of the Creator." - N.2

4. Discussion

4.1 Findings

This study provides a comprehensive examination of the impacts of mining operations on the quality of life of local communities in Chingola, Zambia, within the broader context of achieving a 'just' energy transition. This ‘just’ transition aims to ensure that the benefits and burdens of the shift from fossil fuels to renewable energy sources are equitably distributed, leaving no one behind (Petersen, 2023). While mining activities are integral to the supply of critical minerals, necessary for renewable energy technologies, they present both economic opportunities and significant challenges. This study makes evident that although mining contributes to local economies and welfare by creating job opportunities and building/maintaining social- and transportational infrastructure, these benefits are not always equitably shared, with many community members experiencing income disparity and income insecurity. This is an important finding, as this study further shows that economic satisfaction, which is primarily influenced by income focused factors (e.g. employment opportunities and income insecurity), is found to be the most crucial life domain in determining quality of life. The importance of employment created by the mining sector becomes further evident with the data showing a higher quality of life among those who are employed, especially those who are employed in the mining sector. With mining operations projected to increase due to the energy transition, it evokes the assumption of the creation of more mining employment opportunities, therefore positively influencing the quality of life of residents in mining towns. However, this assumption is questionable, as will be discussed later in this section.

Besides the economic contributions of the mining sector, this study also sheds light on the implications of an abrupt halt in mining operations. The current halt comes from a combination of a lack of CSR and tax payments. However, the data also tells us that CSR and tax revenues are dependent on the success of mine, which is also influenced by the price of the corresponding mineral on the stock market. Although the price of most minerals increased in 2022 due to a surge in demand of electric vehicles and batteries, leading to a more intensive mineral extraction, the price plummeted after the global demand cooled down, causing mines worldwide to struggle to turn a profit (Propp, 2024). As evident by the sudden lack of mining operation in Chingola, such struggles will lead to a decrease in quality of life, as there are way fewer job opportunities, more income insecurity, and more criminality and violence. This sheds light on the most prominent finding of this study, which is the communities dependency on the mine. The lack of alternative employment sectors, whose success is not influenced by the mining sector, give the people of Chingola no alternative to fall back on in cases like these. The quality of life of most residents in Chingola therefore fluctuates with the success of the mine. However, this study also tells us that even if a mine is successful and invests in CSR, political

corruption could prevent the community from receiving the benefits, making it more difficult to deal with CSR issues in general. Another problem is the presence of mining companies that aim for short term profits, which invest their profit in future mining locations instead of local CSR. These short-term objectives ensure that such companies have less to worry about future support from the community, which degrades the need to make local investments. This emphasises the need for strong policy and reliable authority. As evident from this study, strong policy and authority is also needed in making sure the re-use of mining dump sites happens in a responsible way, meaning adequate safety measurements and the control on illegal miners. Carmo et al. (2020) also highlights the environmental pollution and degradation associated with dump site mining. However, with an estimated mineral and metal waste of over 100 billion tonnes per year (Tayebi-Khorami et al., 2019), the recycling- and job opportunities are significant.

Although mining is currently the most prominent (direct/ indirect) employer in Chingola and many other African cities (Bauer, 2023), the data highlights the fear among the population in regards to the persistent modernization of the industry, which will potentially make low-skilled mining employees abundant (Inter Governmental Forum, 2023). Contrary, modernization potentially creates more higher-paid job opportunities for high-skilled individuals. In the case of Chingola, where a majority of the population is not 'high-skilled' and have few employment alternatives, this will likely only exaggerate the inequality between those "who have" and those "who don't have". Therefore, the Inter Governmental Forum (2023) proposes the so called 'inter-industry collaboration', in which the employer should guarantee redeployment in a different branch. Moreover, modernization also has the potential to increase safety and job opportunities for women (Corneau, 2019). As the study shows that women in Chingola have significantly less mining employment opportunities, the modernization could potentially have a positive impact on gender equality. Another development is the implementation of technological 'ready to use' capabilities designed to quickly lower costs, reducing the opportunities for local entrepreneurs to participate in the mining value chain (Olvera & Iizuka, 2023). Therefore, despite the upward trajectory of mineral demand, the positive aspects of mining are not automatically increasing, potentially even decreasing with less low-skilled jobs and more 'ready to use' technological capabilities. As towns like Chingola are fully dependent on the job and business opportunities provided by the mine, diversification of the economy is more a necessity than a luxury.

While modernization might pose a threat for the local communities in terms of a reduction in employment, the modernization of the mining industry seems to be necessary to increase the sustainability of the mining activities (Buzinkay, 2022). As evident from this research, the mining induced pollution and degradation heavily influences residents general satisfaction with their environment, which is extremely important for an individual's quality of life. These impacts pose severe health risks to the human and the nonhuman environment, particularly those in close proximity

to the mine. Due to the lack of CSR, in combination with potential corruption within the government, the people suffering from the mine are barely compensated. The lack of compensation from mining induced negative impacts is a common phenomena (Hilson, 2002). Therefore, this study advocates for an independent (reliable) mining complaints office, which would be located in important mining regions to increase its accessibility. However, not only modernization is helpful in combating the negative mining related impacts, as this study also emphasises the need for stringent environmental regulations and control.

In short, the modernization of the mining industry seems to be having a negative impact on the benefits of mining - which have a positive influence on residents quality of life - and a positive impact on the costs of mining - which have a negative impact on quality of life. In order to make mining towns like Chingola prone to the future and in line with a 'just' energy transition, policy interventions need to be implemented to guide the modernization is a responsible way. These policies are advised to focus on the diversification of the economic sector, as this would provide space for mining companies to apply sustainable and efficient modern technologies without concern about its impact on the job market. In order to make sure that the responsibility to diversify is not only put on the government, it is recommended to make diversification of the local community a mandatory component in the mining companies' CSR programs. By doing this, the primair benefitter of the mineral exploitation (the mining company) is put up with the task to prevent/reduce a communities dependency on the mine.

4.2 Limitations

Quantitative study sample

Not all of the demographic categories in the survey study sample are equally represented (Appendix F, Table.12). This is especially the case when looking at the area of residence, as only Chingola central, Nchanga North, and Lulamba have 40 respondents or more. This unequal distribution negatively affects the generalizability of the study results. By combining neighbourhoods based on their proximity to the mine (Appendix B), this limitation has been minimised. However, no conclusions can be drawn regarding specific areas, which would have been helpful in identifying the distribution of PMI and NMI. Furthermore, by excluding the 'retired' response from the analysis, and therefore from all regressions incorporating the demographic variables, it makes the 'older' age groups become less represented in the age variable. Another limitation is the exclusion of the 'mining-position' and 'mining-experience' variables, as Dikgwatlhe & Mulenga (2023) has shown its significant influence on quality of life.

Qualitative study sample

An important limitation of this research is that no data has been collected from 'year-round' farmers, who, unlike seasonal farmers, rely heavily on water from the rivers. Consequently, they are expected to be adversely affected by water contamination caused by the mine. Data from these farmers is crucial, as governmental actors have expressed interest in increasing investment in the agricultural sector due to the modernization and mining dependency. This aligns with national goals, as agricultural investment ranks among the top priorities of the Zambian government (ZDA, 2020).

Another limitation is that the secondary school students in the focus group had a well-educated geography teacher who researched mining impacts himself. This could explain their high awareness, potentially skewing perceptions compared to their peers.

Analysis

The analysis has been done in a listwise manner, causing the regressions to have way fewer responses in comparison with e.g. pairwise deletion. Although it might negatively influence the generalizability of the result, it does help in producing unbiased results (Van Buuren, 2018), as the dataset consisted of missing random observations. It must also be acknowledged that observed quantitative findings might still be influenced to some extent by external non-mining related factors which are not included in the framework, therefore lacking full robustness. However, by incorporating the most prominent (literature based) non-mining related factors, the statistical results are more accurate then they would have been without. Finally, it's important to note that the survey questions regarding the mining impacts did not specify whether they pertained to the current situation or a more general timeframe. Consequently, the responses, particularly those relating to the positive impacts, might differ in periods when the mine is fully operational.

4.3 Recommendations for future research

While this research offers valuable insights into how the presence of mining impacts various aspects of quality of life, there is a need for further investigation into the influence of political control and governmental strategies on balancing the positive and negative effects of mining. Such research would shed light on necessary political actions needed to ensure a positive and sustainable impact on the quality of life of local residents. Moreover, given the significance of CSR in determining quality of life, it is advisable for future studies to incorporate CSR as a foundational element when measuring quality of life in mining towns. Lastly, due to potential biases in measuring the mining impacts during the survey, it is advisable to conduct the survey again when the mine is fully operational. This will not only ensure the accuracy of the data but also allows for a comparative analysis under different operational conditions.

5. Conclusion

By employing a Mixed Method Approach, this study investigated the impact of extensive open-pit mining on the quality of life of local communities in Chingola, Zambia. The findings indicate that a majority of the residents feel that their quality of life is impacted a lot by the mining presence. When looking at how the residents are impacted by the mine, the results indicate a complex interplay of positive and negative impacts. On one hand, mining significantly contributed to local employment and social- and transportational infrastructure development (CSR), which has enhanced quality of life for many residents. However, the employment benefits are not evenly distributed, leading to income disparities and income insecurity within the community, from which the latter is primarily applied to those who are unemployed, which are often also lower educated. Moreover, women highlight having fewer mining (related) job opportunities than men.

This economic 'polarisation' is further exacerbated by the negative environmental impacts caused by mining activities, as those who are unemployed experience significantly more air pollution, and those who are lower educated express more noise and dust pollution. This could be primarily attributed to the proximity to the mine, as those who are higher educated live in more expensive houses further away from the mine. The importance of mining proximity can also be seen in the fact that those who live close to the mine highlight having poorer water and air quality, suffer more from housing damage due to the mining explosions, and are less satisfied with their living location, which has been found to be significantly important in determining quality of life. Those whose health is negatively affected by the mine, but not work for the mine, are not compensated for their suffering, exaggerating the inequality between the mining beneficiaries and the remaining population. Contrary to what the local authorities claim, compensation for the negative mining induced impacts are more the exception than the rule. This could be attributed to a lack of accessibility (where to complain) and reliability (corruption). This is important as residents who are dissatisfied with their environmental conditions tend to have significantly lower satisfaction with the mine in general. In contrast, those who work in mining or mining-related jobs, typically higher educated, are generally more satisfied with the mine than those whose income does not depend directly on it. Moreover, a lower satisfaction with the mine has been found to be significantly correlated with a lower self expressed quality of life score. Contrary, an increase of satisfaction in terms of economic conditions is significantly correlated with an increase in quality of life score. Therefore, employed individuals, primarily those employed by the mining sector, indicate to have a better quality of life than those who are unemployed. The Chingola residents are however totally dependent on the direct and indirect employment opportunities created by the mine. A sudden halt therefore has disastrous consequences, as it leads to income insecurity and a lack of job opportunities, ultimately causing an increase of crime and violence. The rise of modern mining technologies could have the same consequences, as low-skilled mining job opportunities

would potentially reduce. However, to mine in a sustainable way, these modern technologies seem to be needed. It is therefore of utmost importance to address the negative impact of modernization. According to this study, this requires a reduction in mining dependency.

To conclude, to make mineral extraction - as part of the energy transitions - 'just', diversification investments are advised to be mandatory in CSR programs, more responsibility must be taken in preventing environmental degradation and pollution (regulations & control) - in particular in regards to vulnerable areas/groups within the community -, and the compensation process must be made more accessible and reliable, which could be done by initiating an independent complaint office. These measurements would potentially improve and stabilise the residents quality of life as it would: decrease the communities dependency on mining profits and job opportunities; decrease the environmental degradation and pollution; and increase the compensation for the harm being done by the mine.

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Appendix A - Indicator validation

Table.9| *Selected quality of life indicators based on literature; *Mining orientated research.*

Indicator	*Source used*
Geographical conditions	
Hospital proximity	(Levasseur et al., 2015)
Bus station proximity	(Levasseur et al., 2015)
Train station proximity	(Levasseur et al., 2015)
Main road proximity	(Brinkman & Lin, 2022)
Hospital proximity	(li et al., 2019)*
Housing conditions	
Number of bedrooms	(li et al., 2017)*
Number of bathrooms	(li et al., 2017)*
Housing material	(Riva et al,. 2022)
Housing costs	(McDonald, 2012)
Electricity supply	(Abuqamar et al., 2023)
Social conditions	
Relationship quality	(li et al., 2019)*
Community participation	(Mactaggart et al., 2017)
Neighbourhood security	(Levasseur et al., 2015)
Labour migration	(li et al., 2019)*
Income disparity	(Dikgwatlhe & Mulenga, 2023)*
Environment conditions	
Water quality	(Noronha & Nairy, 2005)*
Air quality	(Noronha & Nairy, 2005)*
Dust pollution	(li et al., 2017)*
Noise pollution	(Noronha & Nairy, 2005)*
Land aesthetics	(Noronha & Nairy, 2005)*
Personal conditions	
Sleep	(Riva et al., 2022)
Esteem	(Skevington, 2020)
Physical activity	(Márquez et al., 2020)
Personal time	(Wang et al., 2010)

General health	(li et al., 2019)*
Economic conditions	
Household income	(li et al., 2017)*
Direct employment opportunities	(Dikgwatlhe & Mulenga, 2023)*
Indirect employment opportunities	(Dikgwatlhe & Mulenga, 2023)*
Training/ learning opportunities	(Jønsson & Fold, 2009)
Income uncertainty	(Godinić, 2020)
Demographics	
Sex	(li et al., 2017)*
Age	(Gobbins & Remmen, 2017)
Relationship status	(li et al., 2019)*
Household size	(li et al., 2017)*
Education level	(li et al., 2017)*
Area of living	(li et al., 2017)*
Employment status	(Dikgwatlhe & Mulenga, 2023)*
Employment sector	(Dikgwatlhe & Mulenga, 2023)*
*Years in mining sector	(Dikgwatlhe & Mulenga, 2023)*
*Position in mining sector	(Dikgwatlhe & Mulenga, 2023)*

Appendix B - Survey

Objective Questions:	Answer options:	Points:	Subjective Questions:	Answer options:	Points:
		Demographics			
Q.1 Where do you live?	• Kapisha • Kabundi East • Chingola East • Kabundi North • Kabundi • Chingola Central • Nchanga North • Chiwempala • Chabanyama • Gibson Chimfwembe • Chawama • Lulamba • Mimbula • Kasompe • Maiteneke • Not in Chingola • Prefer not to say		• 1 • 2 • 3 • 2 • 2 • 3 • 1 • 1 • 1 • 1 • 2 • 2 • 3 • 3 • 1 • - • -
Q.2 What is your sex?	• Male • Female				• 0 • 1
Q.3 What is your age?	• Open				= Age
Q.4 Please select the option that best describes your relationship status	• Single • In a relationship but not married • Married • Divorced • Widowed				• 0 • 1 • 1 • 0 • 0
Q.5 What is your household size?	• Open				= Size
Q.6 What is your education level?	• Did not attend school • Primary school • Secondary school • College education • University education				• 1 • 2 • 3 • 4 • 5
Q.7 What is your occupational status? *If unemployed or retired, go to Q.9	• Employed • Retired • Unemployed				• 1 • - • 0
Q.8 In which sector do you work?	• Mining sector • Mining related and dependent sector • Non-mining related sector				• 1 • 1 • 0
*If mining/ mining related sector is selected Q.8a How many years have you been working in this sector?	• Open				= Years
*If mining/ mining related sector Q.8a What is your position at work?	• Employee • Supervisor • Manager • Director				• 1 • 2 • 3 • 4
		Overall Quality of Life			
			Q.9 How satisfied are you with your overall life? - 0-20 = strongly dissatisfied - 26-40 = Somewhat	• Range 1-100	= Range

			dissatisfied - 41-60 = neutral - 61-80 = Somewhat satisfied - 81-100= strongly satisfied		
Mining Perception					
Q.10 How much does the presence of the mine impact your quality of life?	• None at all • A little • A moderate amount • A lot	• 1 • 2 • 3 • 4	Q.13 How satisfied are you with the presence of the mine?	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.11 What are the positive impacts of mining to you/ your community? - Select as many as you can and feel free to add more!	• Household income • Opportunities to work in the mines • opportunities to work in other mining related businesses • Training/ learning opportunities • None of the above • Other: —-	-			
Q.12 What are the negative impacts of mining to you/ your community? - Select as many as you can and feel free to add more!	• Income insecurity • Income disparity in community • Health impacts • Water pollution • Noise pollution • Air pollution • Dust pollution • Deterioration of the landscape • Less safety (more crime and violence) • Labour migration • None of the above • Other: —-	-			
Environment conditions					
Q.14 How is the quality of your drinking water?	• Excellent • Good • Fair • Poor • Very Poor	• 1 • 2 • 3 • 4 • 5	Q.19 How satisfied are you with your living conditions? Considering aspects such as drinking water quality, pollution, landscape.	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.15 How is the air quality in your neighbourhood?	• Excellent • Good • Fair • Poor • Very Poor	• 1 • 2 • 3 • 4 • 5			
Q.16 Do you experience any dust pollution in your neighbourhood?	• No never • Sometimes • Often • Yes always	• 1 • 2 • 3 • 4			

Q.17 Do you experience any noise pollution in your neighbourhood?	• No never • Sometimes • Often • Yes always	• 1 • 2 • 3 • 4			
Q.18 Do you experience a degradation of the natural environment in the Chingola area?	• Yes, on a big scale • Yes, a little bit • No, it stays quite the same • No, it gets better	• 4 • 3 • 2 • 1			
Economic conditions					
Q.20 What is your monthly household income? If you prefer not to disclose this information, feel free to proceed to the next question.	• Open	= Income	Q.25 How satisfied are you with your household income and the working possibilities you have?	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.21 Are there many opportunities for you to work in the mines?	• No there are not • Only sometimes • Often • Yes always	• 1 • 2 • 3 • 4			
Q.22 Are there many opportunities for you to work in other mining related businesses?	• No there are not • Only sometimes • Often • Yes always	• 1 • 2 • 3 • 4			
Q.23 Are there many training/ learning opportunities for you?	• No there are not • Only sometimes • Often • Yes always	• 1 • 2 • 3 • 4			
Q.24 How would you rate the level of income uncertainty in your household?	• Non-existent • Low • Moderate • High	• 1 • 2 • 3 • 4			
***Social* conditions**					
*If 'Married'/ 'In relationship but not married' is selected at Q.4 Q.26 On a scale of 1 (bad) to 10 (good), how do you feel about your relationship?	• Range 1-10	= Range	Q.31 How satisfied are you with your overall social life? Considering aspects such as relationship, community participation, neighbourhood safety, and cohesion.	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.27 Do you participate in community activities?	• No never • Sometimes • Often • Yes always	• 1 • 2 • 3 • 4			
Q.28 How safe is your neighbourhood in terms of violence and criminality?	• Very unsafe • Unsafe • Neutral • Safe • Very safe	• 5 • 4 • 3 • 2 • 1			
Q.29 Are there many labour migrants living in your area? (so people who moved to your area to find jobs)	• No, none • Only a few • Yes, many	• 1 • 2 • 3			

Q.30 How would you rate the level of income disparity in your community?	• None • Low • Moderate • High	• 1 • 2 • 3 • 4			
Geographical conditions					
Q.32 How far do you live from the nearest hospital?	• 0-1 Kilometres (km) • 1-2 km • 2-3 km • 3-4 km • 4+ km	• 1 • 2 • 3 • 4 • 5	Q.37 How satisfied are you in terms of your living location? (distance to services, e.g. hospital, train station, work)	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.33 How far do you live from the nearest bus station?	• 0-1 km • 1-2 km • 2-3 km • 3-4 km • 4+ km	• 1 • 2 • 3 • 4 • 5			
Q.34 How far do you live from the nearest train station?	• 0-1 km • 1-2 km • 2-3 km • 3-4 km • 4+ km	• 1 • 2 • 3 • 4 • 5			
Q.35 How far do you live from the main road?	• 0-1 km • 1-2 km • 2-3 km • 3-4 km • 4+ km	• 1 • 2 • 3 • 4 • 5			
Q.36 How far do you live from the nearest mining area?	• 0-1 km • 1-2 km • 2-3 km • 3-4 km • 4+ km	• 1 • 2 • 3 • 4 • 5			
Personal conditions					
Q.38 How many hours do you sleep in total each day?	• 1-3 • 3-6 • 6-9 • 9+	• 1 • 2 • 3 • 4	Q.43 How satisfied are you with your own physical and mental health?	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.39 How happy are you with yourself on a scale of 1 to 10?	• Range 1-10	= Range			
Q.40 How many hours a week are you physically active (e.g. physical job, sports etc)	• None • 1-3 • 3-6 • 6-9 • 9-12 • 12-20 • 20+	• 1 • 2 • 3 • 4 • 5 • 6 • 7			
Q.41 How many hours of free time do you have each day (so time you are not working, travelling to/ from work and not sleeping)	• None • 1-3 • 3-6 • 6-9 • 9-12 • 12-20 • 20+	• 1 • 2 • 3 • 4 • 5 • 6 • 7			
Q.42 How would you indicate your own health (0	• Range 1-100	= Ra			

horrible - 100 perfect)		n g e			
***Housing* conditions**					
Q.44 How many bedrooms do you have in your house?	• one • two • three • four • five • more	• 1 • 2 • 3 • 4 • 5 • 6	Q.49 How satisfied are you with your housing conditions? (In terms of space, price-quality ratio etc)	• Strongly Dissatisfied • Somewhat Dissatisfied • Neutral • Somewhat Satisfied • Strongly Satisfied	• 5 • 4 • 3 • 2 • 1
Q.45 How many bathrooms do you have in your house?	• None • one • two • more	• 1 • 2 • 3 • 4			
Q.46 What is the roof of your house made of?	• Grass • Iron sheets • Asbestos • Concrete	• 1 • 2 • 3 \ 4			
Q.47 How much do you pay for rent? (monthly total in Kwacha). If you don't pay rent or you prefer not to disclose this information, feel free to proceed to the next question.	• open	= R e n t			
Q.48 Do you have electricity access in your house?	• No • Yes	• 0 • 1			

Appendix C - Consent form

English version:

INFORMED CONSENT FORM
A survey on neighbourhood characteristics

Dear participant,

I am a student from Utrecht University (UU), which is a university in the Netherlands. Currently I am conducting a research survey as part of my master thesis and I would like to request your participation. Your input is valuable as it will provide insight into how the mining activities in Chingola influences housing prices of the community. As an independent student, I am interested in understanding this relationship as it could help future mining projects with sustainable planning.

Guidelines of the survey:

- You are 18 years old or older
- Your response will be kept confidential and used for research purposes only
- Your data (name and address) will not be used on any documents or presentations
- Your data (name and address) will not be shared with any third parties
- Your participation in this survey is voluntary and you are able to withdraw from the survey any time you want (even after the survey has been conducted)
- There are no risks associated with this survey
- To keep your data anonymously, all data will be analysed collectively and individual answers will not be traceable back to you
- Your data will be stored secure until 31-12-2024

The survey will take approximately 5 minutes to complete.

If you have any questions or concerns after the survey has been conducted, please do not hesitate to contact the researcher of this study: m.vanbaarle@students.uu.nl

By selecting 'Yes', I hereby confirm that: I have read and understand the guidelines of the survey; I have had the opportunity to discuss the purpose of the study, the consent form, and any other questions related to the study; I want to participate voluntarily in this survey.

Yes O
No O

Sincerely,
Mathijs van Baarle
Utrecht University

Appendix D - Positive and Negative impacts

Table.10| *Variables under research.*

Mining related factors		
Negative Mining Impacts (NMI)	**Positive Mining Impacts (PMI)**	**Mining Related Indicators (MRI)**
Income insecurity *Income disparity* *Health impacts* *Water pollution* *Air pollution* *Noise pollution* *Dust pollution* *Deterioration of the landscape* *Less safety (more crime and violence)* *Labour migration* *Housing price degradation* *General Health*	*Household income* *Opportunities to work in the mines* *Opportunities to work in other mining related businesses* *Training/ learning opportunities*	*Employment sector* *Years employed in mining sector* *Position in mining sector* *Mining area proximity*

Table.11| *Positive and negative impacts linked to the mining presence (which were not included in the pre-defined list).*

Positive	**Negative**
• Boosts the towns and countries economy • Corporate social responsibility of the mine does (e.g. built and maintain roads - Infrastructure, schools - Education and hospitals - Healthcare)	• Dependency • Not enough funds attributed to sustain the livelihoods of those who work in the mining environment • Government not benefiting from the taxes (as the mine usually declare loses in Zambia) • Mines sabotage the government by creating tension and uncertainty (firing people) among the populace. This in order to get better deals/ policies. • Displacement of people

Appendix E - Answer distribution mining related impacts

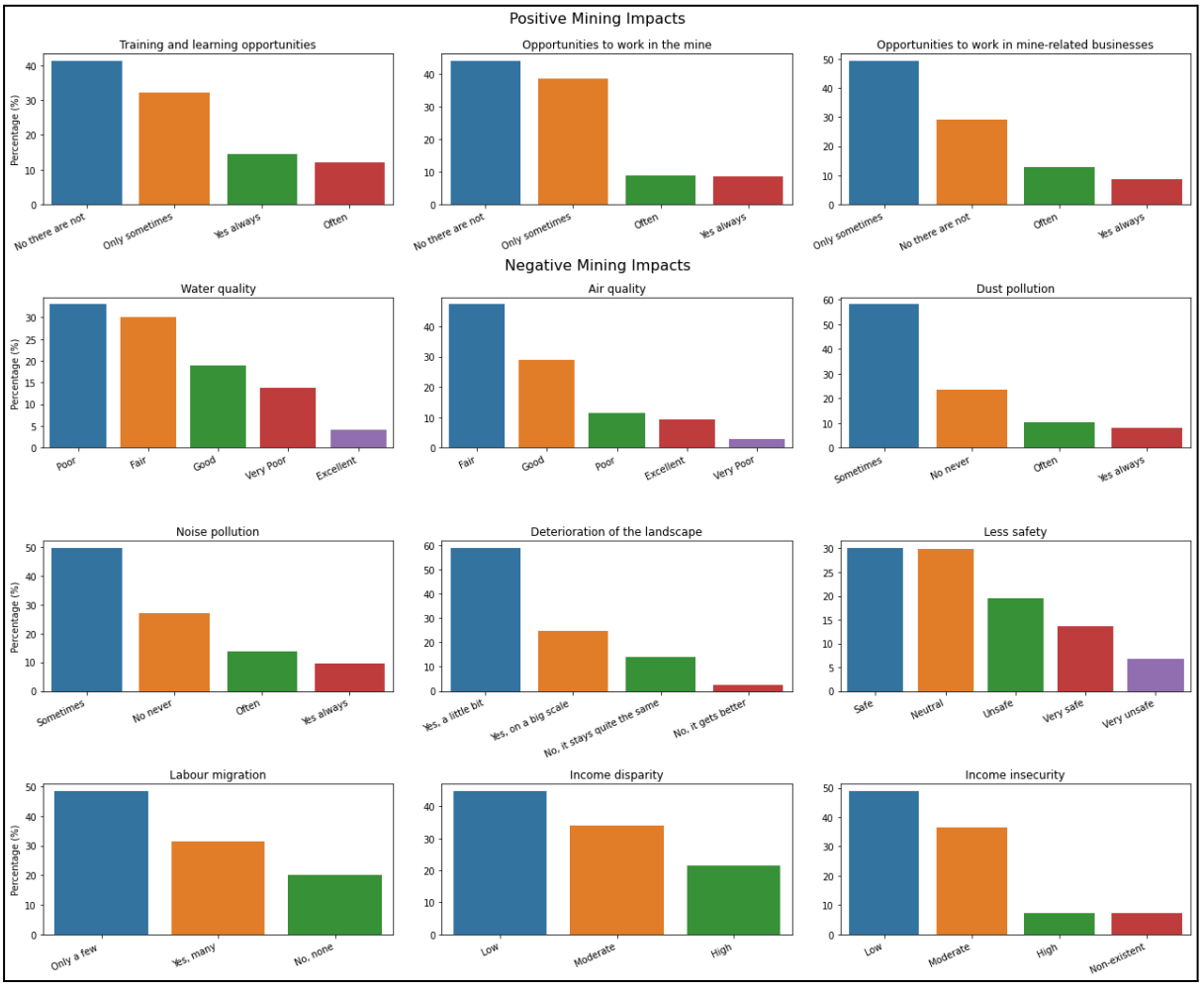

Fig.18| *Distribution of the positive and negative mining impacts (categorical variables).*

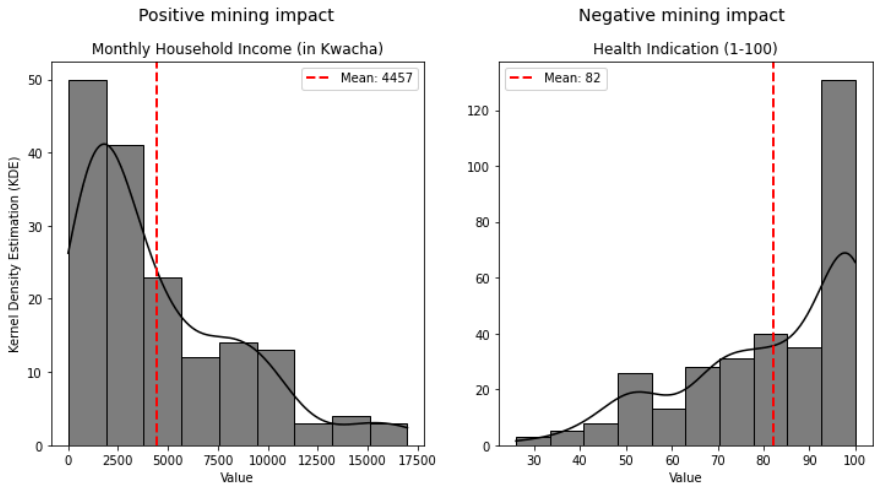

Fig.19| *Density distribution of monthly household income (positive mining impact)) and health indication (negative mining impact) (numerical variables).*

Appendix F - Study sample

Table.12| *Demographic statistics of the survey sample (- = No data available).*

Variable	Category	Study sample (N=394)	
		N	%
Demographics			
Neighbourhood of residence (N=386)	Kapisha	22	5,7%
	Kabundi East	27	7%
	Chingola East	10	2.6%
	Kabundi North	29	7.5%
	Kabundi	14	3.6%
	Chingola Central	49	12.6%
	Nchanga North	102	26.3%
	Chiwempala	27	7%
	Chabanyama	12	3.1%
	Gibson Chimfwembe	1	0.3%
	Chawama	1	0.3%
	Lulamba	40	10.3%
	Mimbula	13	3.4%
	Kasompe	14	3.6%
	Maiteneke	6	1.5%
	Not in Chingola	2	0.5%
	Prefer not to say	19	4.9%
Sex (N=371)	Male	225	60.6%
	Female	146	39.4%
Age (N=375)	Mean= 31.67 Min= 16 Max= 68	-	-
Relationship status (N=384)	Single	166	43.2%
	In a relationship but not married	48	12.5%
	Married	157	40.9%
	Divorced	6	1.6%
	Widowed	7	1.8%
Household size (N=340)	Mean= 5.47 Min= 1 Max= 14	-	-
Education level (N=390)	Did not attend school	2	0.5%
	Primary school	13	3.3%
	Secondary school	140	35.9%
	College education	121	31%

	University education	114	29.2%
Employment status (N=384)	Employed	189	49.2%
	Retired	9	2.3%
	Unemployed	186	48.4%
Sector of work (N=172)	Mining sector	76	41.1%
	Mining related and dependent sector	25	13.5%
	Non-mining related sector	84	45.4%
Number of years in Mining (related) sector (N=92)	Mean= 10.87 Min= 1 Max= 35	-	-
Position in Mining (related) sector (N=104)	Employee	51	49%
	Supervisor	34	32.7%
	Manager	16	15.4%
	Director	3	2.9%

Table.13| *Qualitative research study sample; N= number of the interview/ focus group discussion.*

Actor categories:	***Data collected:***
Interviews	
Government	• Mayor (N.10 - Male) • District Commissioner (N.7 - Male)
Health care	• Doctor (N.13 - Male) • Nurse (N.14 - Female)
Farming	• Seasonal farmers (N.3 and 4 - Male and Female)
Mining (direct)	• KCM worker/ small-scale mine entrepreneur (N.6 - Male) • Retired mine worker (N.3 - Male)
Mining (indirect)	• CEO of mineral trafficking company (N.11/12 - Male) • Mining supplier (N.4 - Female)
Non-mining related	• Hotel managers (N.1 and 5 - Female and Female) • Tele-com specialist (N.2 - Male) • Security guard (N.9 - Male) • Police officer (N.8 - Male) • Former teacher (N.11/12 - Female)
Focus Group Discussion	
Young adults	• 40 Secondary school students (age 16-18) (N.1 - Boys and Girls)

Appendix G - Participatory research observations

Table.14| *Participatory research main findings.*

Observations
Behaviour ● Older people have been more friendly compared to young adults (teenagers). ● Older people and children are more open for conversation, smile more, and express less angry faces. ● Many teenagers are 'chilling' on the street during the day. A large portion of them are under the influence of substances (mostly alcohol). ● Most of the beggars are also in their early 20s/ 30s. ● People often asked me for jobs and money (and offered prostitutional services).
Atmosphere ● The larger houses (in the nicer areas) are heavily guarded. ● People are discouraged to walk on the streets between sunset and sunrise. ● Continuous tension when walking on the streets. ● Politics plays a big role. Supporters of both the current- and former party in charge were attending the Youth Parade (on youth day). The whole mining situation (who to blame?), is a topic often highlighted when talking with the supporters. ● Besides a lot of dust, most streets are really clean.
Way of living ● There are many people living in close proximity to the mine. These houses are often in poor conditions. ● At specific times (e.g. 18:00), there is an alarm going off in the areas near the mining site, which prepares the people for an upcoming explosion. The people now use it as a reminder of the time, as some are already used to the blastings. ● Large differences between neighbourhoods in terms of housing quality and -size. ● In the past, people could drink water from the tap safely, but now they should not. However, most people cannot afford to buy safe drinking water. ● Only the main roads are made of asphalt, the remaining roads are in poor condition . ● Women are primarily working in the hospitality- and cleaning business.
Facilities ● The mining company make sure that people know about their contribution by making big signs. ● Most facilities are in close proximity to the mining area (e.g. hospitals, football fields. ● The hospital for mining employees/ local government is more advanced, compared to the 'local' hospital. ● Many facilities are not in use/ not well maintained. ● The local Football Team, The Nchanga Ranger F.C. is doing a lot worse than before.

Appendix H - Focus group discussion leading questions

1. **Secondary school (40 students, age 16-18, geography course)**

Leading questions:

- How is the mining activity here impacting the pupils? (health, future, facilities etc)
- What are the positive and negative impacts of mining impacts?
- What is the importance of mining in a global perspective?
- How big of a role does mining play in the students' career ambitions?
- What has changed throughout the years? (extraction methods, scale etc)

Appendix I - Focus group discussion summary

The students were well aware of the diverse range of positive and negative impacts related to mining. Mentioning impacts as acid rain, water contamination, air- and noise pollution, employment, income, supporting facilities (sporting, health, free education), supporting people by giving them cooking supplies. They did however emphasise the positive impacts, as employment, income, and education is the main concern for the future of these children. They were also expressing their sense of dependency on the mine, but displayed no ambition to diversify, as the majority of the class wants to work for the mining sector after finishing school (secondary/ college/ university). The teacher himself has also done research about the environmental impacts of mining, and was therefore able to bring this knowledge over to the students. The teacher also mentioned that many houses near the mining area are having cracks in them due to the explosions that are being used in the mine. The people need to be relocated, there is however much uncertainty about that, therefore negatively impacting the livelihoods of these people. The majority of the students didn't really realise the issue that comes with being dependent on the mine, and the social problems that arise with them (like income uncertainty). Most of them also indicated to have seen a negative impact since the mine is not operational, referring to a lack of income, increase in crime, and an uncertain future.

Appendix J - Interview leading questions

1. **Hotel manager**

Age: 36
Sex: Female

Leading questions:

- Can you give a short introduction of who you are and the kind of work you do
- Could you describe the current mining situation? Has this been different in the past?
- How dependent is your work/ income on the mining industry in this area?
- If dependent: Do you often experience uncertain periods? So periods where you may doubt the future of this business you are in? And how has the stopping of the mining operation influenced your business?
- What do you see as the general positive impacts of the mining industry in this area?
    - What are the positive impacts of the mining that you experience?
- What do you see as the general negative impacts of the mining industry in this area?
    - What are the negative impacts of mining that you experience?
- In general, how happy are you with the mining presence in this area? and why?
- If you could change something now about the whole mining situation in this area, what would you do?

2. **Business partner of a tele-communication company/ currently unemployed**

Age: 41
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you do
- Could you describe the current mining situation? Has this been different in the past?
- How dependent is your work/ income on the mining industry in this area?
- If dependent: Do you often experience uncertain periods? So periods where you don't know if you will get enough money?
- What do you see as the general positive impacts of the mining industry in this area?
    - What are the positive impacts of the mining that you experience?
- What do you see as the general negative impacts of the mining industry in this area?
    - What are the negative impacts of mining that you experience?
- In general, how happy are you with the mining presence in this area? and why?
- If you could change something now about the whole mining situation in this area, what would you do?

3. **Retired miner (retired) & farmer**

Age: 69
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- How dependent is your work/ income on the mining industry in this area?
- If dependent: Do you often experience uncertain periods? So periods where you don't know if you will get enough money?
- Could you describe the development of mining in this area? from the moment when you grew up, the stories you have been told from your parents, up to now with the recent closing of the mine.
- How did you experience working in the mines?
    - What were your tasks?
    - What were the positive aspects of working in the mines?
    - What were the negative aspects of working in the mines?

- Why did you stop working in the mining sector?
- What would you say are the more general effects of mining on this area? also think about social and environmental impacts.
- In general, how happy are you with the mining presence in this area? and why?
- If you could change something now about the whole mining situation in this area, what would you do?

4. Mining supplier & farmer

Ages: 60
Sex: Female

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- How dependent is your work/ income on the mining industry in this area?
- If dependent: Do you often experience uncertain periods? So periods where you don't know if you will get enough money?
- Could you describe the development of mining in this area? from the moment when you grew up, the stories you have been told from your parents, up to now with the recent closing of the mine.
- How do you experience working in the mining sector?
    - What are the positive aspects of working in the mining sector?
    - What are the negative aspects of working in the mining sector?
- What would you say are the more general effects of mining on this area? also think about social and environmental impacts.
- How does the mine impact your farming
- In general, how happy are you with the mining presence in this area? and why?
- If you could change something now about the whole mining situation in this area, what would you do?

5. Hotel manager/ Retired British teacher

Age: 80
Sex: Female

Leading questions:

- Could you tell us a bit about your life, how you ended up in Chingola and why you are still here, and what kind of work you do?
- How dependent is your work/ income on the mining industry in this area?
- If dependent: Do you often experience uncertain periods? So periods where you don't know if you will get enough money?
- Could you describe the development of mining in this area as well as of Chingola in general? from the moment when you first arrived here, up to now with the recent closing of the mine.
- What would you say are the positive impacts of mining in this area?
- What are the negative impacts of mining in this area?
- Do you notice any changes in the community since the mine stopped being operational?
- In general, how happy are you with the mining presence in this area? and why?

6. KCM employee & small-scale mining entrepreneur

Age: 29
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- What does KCM exactly do?

- How would you describe the relation between the mine and the people living in Chingola
- How can you see that the mine is impacting the local community here in Chingola
    - Positive (employment, investments in facilities etc)
    - Negative?
- As the mine has often been associated with environmental complains, like water contamination, noise pollution, air pollution and environmental degradation, how does KCM tries do deal with this? (in preventing is and in compensating for the damage)
- Do you think that everyone in Chingola who are negatively impacted by the mine are being compensated?
- If people want to be compensated, how does this go into work?
- How would you describe the balance between the positive impacts and the negative impact of the mine?
- As the mine has not been operational the past month, what would you say are the consequences of that?
- The mine is planned to start being operational again. How will KCM make sure that this will happen in a sustainable way (sustainable for everyone, so the environment, but also the people living here in Chingola).
- Could you describe what small-scale mining is? And what are you doing exactly?
- What are the benefits and costs of small-scale mining?

7. District Commissioner of the Chingola District

Age: 69
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- As a DC, what is your role in regards to the relation with the mining industry here?
- Throughout the years that you have been living in Chingola, which changes have you seen in the mining industry here in Chingola/ community in general?
- How big of a role would you say the presence of the mine plays in the Chingola district?
    - Why is it important? (Tax income for the local government, facilities, employment etc)
- Would you also say that the mining in the Chingola district brings negative impacts? (pollution, contamination of water and soil, natural degradation, health impacts)
    - How does this impact the people living in Chingola?
    - What does the Chingola district do to prevent these negative impacts from happening?
- As a DC, how do you balance between the positive and the negative impacts of mining?
- Have you seen any consequences since the mine has stopped being operational?
- If the mine starts being operational again, how fast do you think it will take for the local community to get back on the same level as when the mine was operating.
- How will the Chingola district make sure that this will happen in a sustainable way (sustainable for everyone, so the environment, but also the people living here in Chingola).
- How do you look at the future of the mining industry in Chingola?

8. Police man

Age: 29
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- How is your work as a police men influenced by the mining in Chingola
- Have you seen any changes in your work since the closing of the mine? (e.g. more violence, criminality etc?)

- What would you say are the positive impacts of the mine for the people in Chingola?
- What would you say are the negative impacts of the mine for the people in Chingola?
- In general, how dependent is the police workforce on money made by the mines?
- In general, how happy are you with the mining presence in this area? and why?
- If you could change something now about the whole mining situation in this area, what would you do?
- How do you look at the future of the mining industry in Chingola?
- If the mine starts becoming operational again, do you think it will have a quick impact on your work?

9. Security Guard

Age: 28
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- How is your work as a guard influenced by the mining in Chingola
- Have you seen any changes in your work since the closing of the mine? (e.g. more violence, criminality etc?)
- What would you say are the positive impacts of the mine for the people in Chingola, and to you specifically?
- What would you say are the negative impacts of the mine for the people in Chingola, and to you specifically?
- In general, how happy are you with the mining presence in this area? and why?
- If you could change something now about the whole mining situation in this area, what would you do?
- How do you look at the future of the mining industry in Chingola?
- If the mine starts becoming operational again, do you think it will have a quick impact on your work?

10. Mayor of Chingola

Age: 45
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- As a Mayor, what is your role in regards to the relation with the mining industry here?
- Throughout the years that you have been living in Chingola, which changes have you seen in the mining industry here in Chingola/ community in general?
- How big of a role would you say the presence of the mine plays in the Chingola district?
    - Why is it important? (Tax income for the local government, facilities, employment etc)
- Would you also say that the mining in the Chingola district brings negative impacts? (pollution, contamination of water and soil, natural degradation, health impacts)
    - How does this impact the people living in Chingola?
    - What does Chingola do to prevent these negative impacts from happening?
- As a Mayor, how do you balance between the positive and the negative impacts of mining?
- Have you seen any consequences since the mine has stopped being operational?
- If the mine starts being operational again, how fast do you think it will take for the local community to get back on the same level as when the mine was operating.
- How will Chingola make sure that this will happen in a sustainable way (sustainable for everyone, so the environment, but also the people living here in Chingola).
- How do you look at the future of the mining industry in Chingola?

11/12. Director at a mining trafficking company & his wife (former primary school teacher in Kenia)

Age: 60 & 51
Sex: Male & Female

Leading questions:

- Could you both give a short introduction of who you are and the kind of work you currently do/ done?
- As you have been around quite some time in the mining sector, and in different countries as well, how would you say that the mining industry impacts the communities where these activities take place?
    - Positive/ Negative
    - Differences between countries?
- Would you say that mining companies take their responsibility in supporting and taking care of the communities?
- Would you say that there are significant differences between mining companies in terms of their social responsibility towards the community? (e.g. Europe, China, India etc)
- As you are now Director at a company that takes care of the transport of primarily processed copper and cobalt from the copperbelt towards ports in the Southern part of Africa, which impacts do you think your company has on the local community here in Chingola/ the area of operation? (Think about aspects such as employment, air/ noise pollution of the trucks → How do you deal with these aspects)
- How do you look at the future of the mining sector, as minerals are now getting more important due to the energy transition?

13. Doctor (Chingola District)
Age: 31
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- How would you say that the mine influences the health of the people living in Chingola? (miners/ non-miners)
- What are the most common mine related diseases that you see in the hospital here and what are the causes?
- Is everyone who is affected able to get treatment?
- Do the mining companies take responsibility for these health problems? (pay treatment, compensations?)
- Have you seen change in regards to the amount of people being impacted by the mine/ the amount of people able to get treatment throughout the years?
- What would you like to see happening? (How can these impacts be prevented?)

14. Nurse (Chingola District)
Age:
Sex: Female

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- How would you say that the mine influences the health of the people living in Chingola? (miners/ non-miners)
- What are the most common mine related diseases that you see in the hospital here and what are the causes?
- Is everyone who is affected able to get treatment?
- Do the mining companies take responsibility for these health problems? (pay treatment, compensations?)
- Have you seen change in regards to the amount of people being impacted by the mine/ the amount of people able to get treatment throughout the years?
- What would you like to see happening? (How can these impacts be prevented?)

15. Environmental Health Officer in Chingola - Ministry of Health
Age:
Sex: Male

Leading questions:

- Can you give a short introduction of who you are and the kind of work you currently do?
- What are the environmental impacts of the mine in Chingola?
    - Examples?
- What are the health impacts of the mine for people living in Chingola?
    - Common mining related diseases?
    - Difference miners/ non-miners (but living close to the mine)?
- Do the mining companies take responsibility for the environmental and health problems?
    - Compensation/ treatment/ prevention actions
- What does the ministry of Health do to prevent these environmental and health problems
- Does the ministry of Health work together with the mining company in Chingola/ mining companies in general?
- Have you seen change throughout the year in regard to the amount of environmental and health impacts?
- What would you like to see change in the future in terms of the mining impacts/responsibility?

Appendix K - Interview summaries

1. Hotel manager

Age: 36
Sex: Female

Summary:
X has been working for a luxurious hotel in Chingola for the past 10 years. The hotel mostly serves people who are working in the mine sector (expats) and mining contractors. Besides accommodations, the hotel is also used as an event location for meetings, parties, catering and to swim. When the mines were thriving, business was thriving as well. Her business is dependent on the mine sector, as these people mostly stay for a long period of time, meaning that the hotel will have a stable income, which is needed to pay all the bills and salaries of the people working in the hotel. In times where the mine is not producing well, they need to cut their expenses by firing people, meaning that many families will be affected. In general, X sees the mine as predominantly having a positive impact on the incomes of people, which is according to her translated into less crime, less stress, better marriages (as women will not divorce to go with working men) and in general a better life. From stories X knows that back in the day the mining companies took more self responsibility and invested more in the community (in which she refers to a diverse range of sporting activities for the youth). After the mining operations have been stopped, she already sees the impact it has on the community. X has been unable to pay the salaries of the staff since December last year. Besides that, she also sees a significant increase in crime, substance use and the negative impact on marriages. She mentioned that also illegal mining is getting harder to do, due to an accident that had happened a couple weeks ago (where illegal miners were killed). Therefore, even more people are having no income anymore. If the mine is working, there are also negative impacts according to X, referring to noise pollution, air pollution and the contamination of water. This leads, according to her, to diverse health impacts. As there are now promises being made that the mine will become operational again in the start of April, X tries to look at the future in a positive way, as she also hears rumours that the water company is working on water safety. X advocates for more responsibility for the mining companies, so that these companies also keep taking care of the community in terms of investment into facilities, by employing as many people as possible, and by taking care of the environmental impacts.

2. Business partner of a tele-communication company & currently unemployed

Age: 41
Sex: Male

Summary:
X is a 41 year old specialist in tele-communication. From his first job on he has been dependent on the mining sector, as they were the primary customers. If the mining companies would do worse, or the stock price of copper would drop, it would directly translate into less work, less income and for some people a delay in their paychecks. According to X, the problem with investors who just stop the mining production has happened many times in the copperbelt region, causing an enormous shock in the local community. X says that the mine is not totally stopped, as there are still people who maintained the mine as good as possible, as otherwise people will start plundering the area and will hinder the reusage of the mine in the future. The plundering of the mine is something that is already happening. The lack of employment opportunities in the citie of Chingola has led to an enormous increase in criminality, in which he refers to thefts, burglaries, robbings, rape and substance abuse. As the dumping sides consist of ground which still has many minerals in it, people illegally (or legally with contracts with small extraction companies) extract the dump ‘waist’ and sell it to the modern companies which can, using modern technologies, extract many elements out of it. The people that illegally enter the mine do not have the right equipment and education, leading to numerous accidents and health impacts. The contamination of the water is according to X also a big problem, which does not suddenly stop when stopping the mining activity as many of the water reservoirs are already contaminated and many rivers are already intruded by salt. According to him, this leads to a lower biodiversity (which could also be seen in the colour of the threes near and worse farming. It also leads to many diseases as people cannot afford to buy fresh drinking water. Other

negative impacts are noise pollution (exploses), air pollution (sand), the degradation of the natural environment, the move/ extinction of many animals, and general health implications. However, X emphasises the importance of mining, as it brings many employment opportunities with it, causing the livelihood of people to increase. It also brings more facilities and services to people (like proper medications etc), causing people to feel less stress, which makes life a lot better. He mentioned that even in a scenario that the mining would stop permanently, the loose sand in the pit will make the sand pollution continue, and the water pollution will continue for a long time as well, as many reservoirs are already contaminated. Therefore, X advocates to create a better balance between the negative and positive impacts, as could be seen in other countries like Australia. A scenario in which the mining is done in a sustainable manner, so that not the local people, the natural environment and the future generations will be impacted in a negative way.

3. Retired miner (retired) & farmer

Age: 69
Sex: Male

Summary:
X is an ex mine worker. He worked as an engineer in the mine in Chingola, and later also in Kitwe, which is a nearby mining company. In the beginning of the mining it was much better then it is now. According to him, that is due to the different scale of the mining, as well as the methods that they are using. The mining companies took care of all their employees, invested in facilities, healthcare, education etc. It also brought more money to the community, which helped the city to develop and to thrive in peace. Around 2002, the government started privatising mining, this resulted in a shift. The companies cared less about the people and the communitie and more about the profit. At the same time, new mining technologies brought more problems with it. Due to the use of many chemicals, the water became more and more contaminated. All by all, many people got sick (primarily diseases like tuberculosis and stomach diseases). In December 2023, the government took in the lease contract which it had with the mine's main investor, as the investor (an Indian company) said that they did not make any profit. However, the investor is now taking the government to court with this. A big problem with the private investors is that when they make profit, they often tend to invest in other countries of areas, and will not end up in the development of the area itself. According to X, the closing of the mine has caused a significant increase in criminality and a decrease in standard of living. Many people are now out of their job and start doing the wrong things. He also refers to a recent accident where people illegally tried to steal material from the dumpsites and became trapped. The stopping of the mining activity also leads to a lower tax revenue for the community, which is translated into less facilities, less services and in general less social responsibility. X also refers that the stopping of a mining activity could separate families, as men need to go to other places to earn an income.

However, X mentions that the mining also brings a lot of problems with it, as he referred to noise pollution, air pollution, landscape degeneration, water contamination and also diseases. All by all, X thinks the costs outweigh the positive impacts of the mine. There is however a big chance that the mine will open again, which will take many years according to X (as they first need to get rid of all the water that has been stacking up in the pit), leading to a continuation of the negative impacts. X advocated for a more sustainable way of mining, in which the company's wil hold to the guidelines and stop polluting the environment.

After the interview, he mentioned that his farming practices are not really negatively affected by the mining, but he does mention that other farmers, who make use of the local water streams, are negatively affected by the silt and chemicals of the mining industry.

4. Mining supplier & farmer

Age: 60
Sex: Female

Summary:

X has been retired for 5 years. Despite her retirement, she works as a supplier of materials for the mine, as well as on her own farm. As her work as a supplier is very dependent on the mining, she often experiences income uncertainty in periods where the mine is not doing well, like the period they are in now (with the mine not being operational). In terms of development of the mine, she says that the mine has not really developed throughout the years, as she refers to the number of people working for the mine, she thinks that different methods of extraction and new technologies have not played a role in this. She lives really close to the mine, therefore she says she had experienced noise pollution, air pollution, dust pollution and water contamination. According to her, water contamination occurs quite frequently and has a long lasting impact. When asked about compensation, she says it is really hard to get compensation. She received compensation only once, and that was through the help of 'outsides' people who came from outside the country. She says that her farm is not negatively impacted by the mine, as she does seasonal farming (making use of natural rain seasons). However, she does say that the people who farm with the use of the local rivers are negatively affected by the water contamination. She also refers to cracks in houses which are located near the mine (not her house, but many in their surrounding communities). These cracks are caused by the explosives used in the mine. She says that she doesn't know anyone who has been compensated for that, as people simply do not know where to go, and do not get any help from the local government or the mining company. She also refers to the health problems related with the mining due to the inhaling of toxins. She said that only some miners with health problems were helped, not all of them, and especially no one from the community nearby the mine, although they were also impacted by the same toxins. Now the mine is not operational, she says that the only thing that has changed is that people are now just staying at home doing nothing, insteads of being outside doing nice things, as people do not have money anymore. Since the mine has stopped most of its operation (as the smelter is still a bit used), she has not experienced any more environmental and social problems. Despite this, she still would like the mine to be operating again for the sake of the community, as otherwise many skilled people will leave the city. However, when the operations start again, she would want that the mining company takes on more social responsibility, referring to more investment in the communities, like investing the money into more parts of the copper chain (instead of just the extraction of the copper. In terms of positive impacts, she only mentioned employment and not the facilities, as according to her, the mine company had only invested in one hospital and one football team.

5. Hotel manager & Retired British teacher

Age: 80
Sex: Female

Summary:
X moved to Chingola in 1963 as a teacher after finishing teaching school in what's now known as Zimbabwe. Her husband had a good job in a mining company in Chingola. In those days, the mining people were mostly white and lived in different neighbourhoods compared to the local people. The white children also went to different schools. There were also not a lot of people with cars, the only one were the white people. Over the years, the mining companies started getting workforce from countries like India, Sri Lanka and the Philippines. According to Allison, they wanted these people instead of the local people as the local people acquired more training. Up til around 1999, the mining companies invested a lot in local sport facilities (football, hockey, swimming pools, golf club etc), but also in health care facilities and the cleaning of the city. However, after changing companies, they got more profit driven and did not want to invest as much in the local facilities. What also started changing is that the mining activities scaled-up, which led to more trucks on the road. Allison mentioned that everyone in Chingola is in some way or another dependent on the mining industry in this area. When asked about the negative impacts, she admits that there is quite some pollution and also water contamination. She said that back in the days people did not really care about this. Allison herself is not affected by this as she can afford bottled water. She also says that it is hard to balance these negative and positive impacts. She also mentioned that the gap between 'those who have, and those who don't' is getting bigger. Another development that happened is that more and more local people are in higher positions, as before only only white people were in those positions. In terms of safety, she says at the end of the century, it got quite bad (referring to shootings and burglaries). Now it is a lot better, although she has heard that there is a resurgence in criminality. But not in the hotel she works in. After Allison stopped teaching, she started to work as the manager

for the Marriott hotel. Although the mine is currently not operational, she has had more people staying at her hotel compared to last year. She also does not really see an impact of the fact that the mine is not really operational, although she does highlight that everyone is dependent on the mine, so it definitely has an impact. Allison also mentioned that there are many unfinished houses in Chingola, as people got a loan and then died or could not afford it anymore. She looks at the future with a patient attitude, 'waiting for something to happen', 'hoping for the best'.

6. KCM employee & small-scale mining entrepreneur

Age: 29
Sex: Male

Summary:
X has been working for KCM in Chingola for 6 years, before that he worked another 1 year at a different mine. X explains that the community is really dependent on the mining industry in Chingola, if the mines are running well, the cash flow is much greater in the whole of Chingola. In the past, before the year 2013, the mining company (Vedanta Resources) was also investing a lot in local facilities (like sporting clubs and hospitals). According to X, they stopped doing so as the Government of Zambia wanted to use that money for something else (later referred to the corruption in the government in these periods). Therefore, less and less money was put into Social Responsibility (investment in the social aspect of the community). After the local people came into protest, the government took over the mine. However, as they did not have the funds to successfully run the mine, there was also no money going into social responsibility. Then Vedanta Resources came back but did not make enough profit to invest into the community. Therefore, the government stopped their operation. This stoppage has significant consequences for the local community, as they are dependent on the cash flow coming from the mine. The unemployment causes the youth (who just graduated) to use more substances, and to an increased rate of criminal behaviour. X admits that mining can also have its negative impacts, like pollution, contamination and health impacts. However, X says that the people who are affected are well taken care of, as they receive large compensations. He also says that KCM takes many measurements in preventing contamination and pollution from happening. He could however not go in great detail about the situation in regards to the dust pollution, as people experience this everyday. He also mentioned that there are toxins in the loose dust, which can have tremendous health impacts when inhaling this. Now Vedanta Resources is coming back, they promised to spend 20 US dollars a year on Social Responsibility (the department for which X will be working). He is sure that this investment will revive the facilities in Chingola and will help the local community in general. As he is also an owner of a small-scale mining company, he takes ore from a place which falls under the control of the government, and then sells it to the Chinese. Therefore, X himself is not really affected by the stoppage of the mine.

After the interview he also talks about the difference between KCM and the Chinese, saying that the Chinese pay way too little and give too much work. At the same time, they hold lower safety standards.

7. District Commissioner of the Chingola District

Age: 71
Sex: Male

Summary:
The District Commissioner (DC) has now been working as a DC for the past three years, before that, he has worked for over 40 years for the local mining company. Throughout the different companies, he held high functions. Now as a DC he forms the link between the community, the mining company and the government. He says that he has a good relationship with the mining company (KCM), and that if there are complaints from within the community, he will address them to the general manager or the COO. Throughout the years, the mining sector has changed a lot, he mentioned that the mining companies were first investing more into the community. After the year 2000, the mining company made less profit and could not invest the same amount of money into the community. This could be seen as the example of the local football club Nchanga Rangers, they

do not get paid enough and therefore are doing less great than before. The DC mentions that the whole community is dependent on the mining industry, as it provides many jobs and many businesses are in some way dependent on the mining sector. The DC highlights this dependency as weakness and therefore advocates for diversification (referring to irrigation and farming). The DC admits that there are also negative impacts of mining, like water contamination, soil and air pollution, but says that these are well taken care of and that the water is only contaminated once in a while. These people do get compensation and also bottles of water by the mining company. He also says that only people who are working in the mines are exposed to toxics, and are therefore the only ones that might suffer from health impacts. These people are checked every year and will be compensated if they become sick due to the mine. The health of people who don't work in the mines are not negatively affected. He also says that only the soil that falls under the mining area is contaminated and not the soil around it, it is according to him not the case that people who farm are negatively affected by the mines pollution. Since the mine is not operational, there has been more crime registered in the city. He also agrees that there is a big contrast between the rich and poor, but also mentions that the government is doing something about that problem. He also says that there is quite a lot of illegal mining going on, these people sell their materials to the Chinese, but the government is only allowing them to buy material from those who are licensed. The DC is happy that Vedanta Resources will be back soon, and estimates that the community will be up and running like never before in four months' time. Furthermore, he thinks bright about the future as Vedanta Resources promised the government to put more money into social responsibility and the community in general.

8. Police man

Age: 29
Sex: Male

Summary:
X is a police agent who primarily takes care of the transportation of police officers. He also responds to emergency calls. His work is really affected by the mining, as the police force is somewhat dependent on social responsibility (as the mining companies give money to the police, but also take care of their fuel and vehicles). Now the mine is not operational, they could feel it as they do not get the social responsibility anymore. While at the same time the stopping of the mine has led to a significant increase in crime (referring to burglaries, theft, illegal mining, and vandalism). As X highlights the importance of the mine, he also mentioned the employment in the community, as mining is the main source of employment and income. He says that If the mine does not start working soon, many skilled people will leave the city. He also mentioned that the stopping of the mine has a huge impact on the families of people who depend on the mine, as they cannot pay the education of their children and will have more divorces (as the women will go to men who do have a job). Illegal mining, which ask much of the police is both a good and bad thing, as it helps unskilled people to make a living, but at the same time can lead to accidents (referring to a accident in December were around 40 people died). Furthermore, the mine is also important as it helps sustaining facilities (e.g. hospitals and schools). He also mentioned that there are also negative impacts related to mining, such as pollution, contamination, degradation of the land, and taking up much of the land. This has a negative impact on agriculture, as people have less space to do agriculture, and the soil that is available is less usable due to the contamination. If the mine starts operating again, he believes that the community will bounce back. However, he thinks that it will take years to come back at the same level as it was before. A short period of stopping thus has a long-lasting negative impact on the community.

9. Security Guard

Age: 28
Sex: Male

Summary:
X is a security guard for a hotel, his job is to make sure everyone is safe and there are no thiefs. He first says that his job is not dependent on the mining in Chingola. However, after the interview continued he mentioned

that because of the mine, which is not operating anymore, he has not received his salary for the past three months. He also says that crime has increased (referring to more thiefs, violence and prostitution). He does not experience negative impacts related to an operational mine, except the dependency. He says that only people who live close to the mine experience air-, noise-, and dust pollution. He lives on the complete other side of town and therefore does not experience these impacts. He also highlights how well the Chingola community is when the mine is running and people have jobs and income. If he could change something about the mining situation, it would be more salary for the people who work in the mines and better safety measures, as he mentioned that these aspects could be improved on. In regards to the future, he feels a bit worried as everything has become more expensive, like electricity, something which the mining sector uses a lot. He also points out that the lack of rainfall will make life in the copperbelt harder.

10. Mayor of Chingola

Age: 25
Sex: Male

Summary:
The Mayor has been in his position for around six years, before that he worked as manager in the mining sector and as a manager at Protea Marriott hotel. He was born and raised in Chingola. Throughout the years, the Mayor has seen many changes happening in the city. Since the Zambian government started the privatisation of most of the government's assets, the mine became in control of a private company, which was more profit driven and did not invest as much in the community. Before that, the government gave people a home if they wanted to work in the mines (at that time there were only 90.000 people living in Chingola). With the private mining company, people needed to start paying for their own things. Then the community started to degrade. Later (at least when Vendetta Resources took over the mine), there was much money being put in the social responsibility, attributing a lot to the local community (referring to free education and facilities). This happened until the government changed. The government did not make sure that there was enough money being put in Social Responsibility. Vendetta resources also said that they were not making profit. Therefore the former government put the mine on liquidation (stopped the operation of the mine). According to the Mayor, this had a huge impact on the economy of the local city as well as for Zambia in general. He agrees that criminality has increased since the mine is not operational. Currently there is a new government in charge (UNPD), and they are making new deals with Vendetta Resources, making sure that they put enough money in the local community (social responsibility). The Mayor admits that people also encounter negative impacts of mining, referring to diverse forms of pollution, water contamination and health impacts. The Mayor says however that these people are well compensated and that many precautions are made to prevent this from happening (like quality checks). He also promises that when Vedanta Resources will be back, the mine is gonna thrive like never before and the community will be revived within months of time. The mine currently employs around 30.000 people from the 300.000 people living in Chingola. This is just the number of direct employees, as the Mayor highlights the importance of most businesses on the mines, many more are indirectly employed by the mine. He looks bright to the future and promises to make sure that the development of the mine will happen in a sustainable way for everyone.

11. / 12. Director at a large scale mining trafficking company & his wife (former primary school teacher in Kenia)

Age: 60 & 51
Sex: Male & Female

Summary:
X has spent many years working in the mining sector in various countries, including the DRC, Uganda, Kenya, Tanzania and currently Zambia. Therefore, he has experienced the impact of different kinds of mining operations/ mining companies on the local communities where these activities take place. His wife, a Kenyan from British descent, has worked as a teacher in Kenya until moving to Chingola. During our discussion we

talked a lot about the impacts of mining on the local communities, the responsibility, as well as steps need to be taken in order to make mining sustainable for all stakeholders.

According to X experience, most (western) mining companies often do a good job in involving the local community, referring to the contracting of local suppliers, transporters and workers. He uses his time in the DRC as an example, in which the gold mine company he worked for really impacted the local people in a positive way by providing income to the people, enabling them to pay for their children's education. These (western) mining companies also often invest in facilities, although both X and his wife agree that this is way less important compared to the investment they need to make in the local businesses (training people to do jobs which are needed in the whole mining chain, creating more jobs in the communities themself, instead that these steps of the process are performed anywhere else. This training also makes the people less dependent on foreigners and the mining sector in the long-run, as these people will be able to provide better education for their children.

X also emphasised the significant difference between western mining companies and Chinese mining companies. He said that in general, the Chinese hold way lower standards in terms of safety measurements, equipment and working conditions. They also said that some local small-scale farmers have to deal with checks, in which they sometimes get fined for small things, while at the same time the Chinese are polluting the environment on a big scale, are having worse working conditions and are mostly making use of Chinese Machinery, -workers etc, and that without getting fined. This brings up the important role of corruption in the governments of primarily African countries. They say that in many of the African countries, especially those that are rich in minerals, are heavily involved in corruption. Making the story of mining companies who are not investing in social responsibility not totally reliable, as governments could also take away this money for different purposes. This also goes for the compensation for those who are negatively impacted by the mine, as compensation is only being done if there is proof that the mining company is responsible for the negative impact. Measurements which are prone to corruption.

X also refers to the negative side of social responsibility (the part which provides people with things, facilities and funds), as it makes these people even more dependent on the mining sector, therefore taking away some internal stimulus. He also gives the example of a case in Tanzania, where the government promised the local community unrealistic expectations of what the mining would bring, this with the goal of collecting political votes. Once the mine had started, people were not satisfied and wanted more and more. Therefore, X highlights the importance of providing realistic expectations, but also the significant influence that politics can have in maintaining a good relation between the mining industry and the local people.

During the conversation, the Maslow hierarchy of needs was mentioned. As in these 'under-developed' places, peoples first priority is survival and making sure the next generation has a better future. Therefore, X and his wife think income (and thus employment) is the most important aspect influencing these people's quality of life. After people are assured of income, people will start to think, worry, and take actions against the negative impacts of the mine, such as pollution, contamination and health implications.

As X mentioned the positive impacts of most large-scale (western) mining operations, he argues that most of the time, the illegal mining/ state-owned mining causes the most negative impacts, as the mines have lower/ no safety standards, and have less money to keep the mine running efficiently, and to contribute to social responsibility. However, he does highlight the problem of short-term profit driven investors, who do not involve- and invest in the community. Back in the day, they said it was maybe more normal to bring over families of people who worked for the mine abroad, creating more of an incentive for those companies to invest in local facilities. This could also be a reason why mining companies would invest less in social responsibility.

X and his wife also see the social effect the mining sector has in Chingola, referring to an increased criminal activity in times with less employment due to less mining activity/ lower profits. Besides criminal activity, they

mentioned that there is quite a gap between those with jobs (especially those in good positions) and those without jobs, creating a sense of social segregation (due to income inequality).

Another problem that comes to the conversation is the modernization of the mining sector, in which more can be done with even less people, therefore providing less employment opportunities to the local communities. According to X and his wife, this underscores the importance of diversification into different sectors, but predominantly the importance of education and training, making people able to expand their capacities outside the mining sector/ into different phases of mineral extraction/ production.

Therefore, the biggest hurdle might be true leadership from within the local/ national governments. As they need to be looking forward, stepping away from corruption, making sure that the mines will thrive in a sustainable way, while making sure to invest in different businesses.

As a director of a mineral trafficking company (ships ore and smelted mineral products from the copperbelt region to different ports in Southern Africa), he mentioned that the positive impacts of the company he works for (not mentioned due to privacy)
are:

- The employment of over 600 people, all which on a proper and legal employment contract (which in many cases exceeds minimum legal requirements)
- Career opportunities
- Training and exposure to good working and management/ leadership practices throughout an Africa-wide corporate structure with its HQ in Paris
- 100% compliant company that follows all Zambian rules, pays all taxes, obeys safety regulations, and provides a European standard HR and legal environment for staff at all levels
- Procurement of services and supplies in the community to support local suppliers wherever possible
- Proper environmental handling of waste lubricants, scrap tyres, old IT equipment , etc

When asked about the negative impacts, he says that they are relatively small compared to the general situation in a place like Zambia. He mentioned the truck's fuel consumption, which pollutes the environment. However, he says there is little option but to use trucks for moving the cargo in this part of the world. The company does invest in rail operations including a small Zambian project and a much larger one from DRC to Angola. According to X, Electric-powered trucks are impractical as there is nowhere near enough electricity to use them, never mind that the production and battery/component waste of EVs arguably creates more environmental and ethical hazard than using diesel trucks in the first place.

When asked about his perspective on the future of mining, he said that the mining sector will continue to be an important part of the global economy. With very little happening anywhere without some aspect of it going back to extraction of basic resources.

13. Doctor

Age: 31
Sex: Male

Summary:
X, a medical doctor specialising in general surgery at Chingola Teaching Hospital Nachanga, manages emergency cases, performs surgeries, and conducts ward follow-ups. He observes a significant impact of mining activities on the health of residents in mining towns, with many suffering from occupational lung diseases like silicosis (due to toxics in the dust) and various mining-related injuries. Although the prevalence of such health issues has decreased due to improved working conditions and modernised mining practices, challenges remain. Bwalya advocates for increased investment by mining companies in healthcare, emphasising the need for better hospital facilities, more specialists, and a focus on the health and productivity of the workforce rather than solely on profit.

14. Nurse (Chingola District)
Age: 31
Sex: Female

X, a nurse at King's Health Post in Chingola's outpatient department, discusses the significant impact of mining on health in the Chingola district. She highlights frequent accidents, including severe injuries from machinery, as well as health problems among miners such as respiratory tract infections from mine dust and smoke, and fungal infections due to prolonged boot wear. X also mentions the health burden on families and healthcare providers when miners get injured. Although mine hospitals like KCM provide treatment and compensation for miners, non-miners often rely on government facilities, which may lack resources. X advocates for better safety measures in mines, including proper gear, safety instructions, and adequate lighting to prevent injuries and improve miners' health.

Appendix L - Interview coding diagram

Table.15| *Interview coding diagram.*

Theme	Categories	Subcategories	Quote examples
Economic impacts	Positive	Employment opportunities	*"if the price of copper goes down at the London stock exchange, we see that could also be delayed in having our salaries in time. So we are affected by the operations of the mining and whatever happens there "*
		Training and learning opportunities	
	Negative	Dependency	
		Income inequality	
		Income insecurity	
Environmental impacts	Negative	Water pollution	*"But we have seen a contamination of our rivers, changes in bio, living things in waters. Things don't the way it used to be. Trees have changed colors because of silt of the outside.[...].The soil has been mutated because of too much chemicals and because of the ore."*
		Noise pollution	
		Air pollution	
		Dust pollution	
		Landscape degradation	
Social impacts	Positive	Facilities	*"And on the non miners, non miners because of the smoke that we're inhaling, you have a lot of coughs, you have a lot of flu, you have a lot of respiratory tract infections because of the smoke."*
	Negative	Health	
		Labour migration	
		Safety	
		Housing damage	
Corporate Social Responsibility (CSR)	Compensation	Taking care of	*"[...] They get cracks. Huge cracks because of the impact of mining and explosives. [..] I haven't seen anybody being compensated because their house got cracked. In fact, they don't even know where to go."*
		Not taking care of	
	Sustainability	Not sustainable	
		Sustainable	
Changes	Modernization		*"There has been also reduction in the budgets or level of commitment into social responsibility. [...] there was a reduction in the services of those sewage."*
	Scale		
	CSR		
Future	Positive	Hopes	*"It's my fear that it can get worse and worse. [...] If they take care of the water contamination and just do the right thing according to the safety of environmental safety guidelines, then it's alright."*
		Promises	
	Negative	Fear	