ASSESSING LAND REHABILITATION IN ARTISANAL AND SMALL-SCALE MINING: THE MZIMBA CASE.

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ABSTRACT

In the mining industry, most attention is focused on the large-scale sector, but in developing countries like Malawi, minerals are mainly extracted by the artisanal and small-scale sector. This means a greater potential of impacts to aspects such as the environment. This project was carried out to assess land rehabilitation in artisanal and small-scale mining in Mzimba district. This was done in consideration of the growing artisanal and small-scale mining sector in Malawi arising from opinions that it brings about significant environmental destruction. The aim was to assess sustainability use of land in Artisanal and Small-scale Mining, focusing on mining closure since; the nature in which the land is left after mining affects its future use. The main objective was to assess the impacts of lack of land rehabilitation in ASM on the environment in Mzimba. The main hypothesis was, "lack of land rehabilitation in small-scale mining does not affect environmental sustainability." The research included a desktop study of Malawi's mining and environmental laws; survey in which purposive sampling was used; and field observation which was used to determine the nature and extent of implementation of land rehabilitation activities and related impacts. This study revealed that in T/A Mzikubola in Mzimba, land rehabilitation is not done. Miners are aware of the need for land rehabilitation but negligence and high cost act as barriers. There is also inadequate monitoring and enforcement of environmental standards by regulatory bodies. Due to lack of rehabilitation; impacts such as loss of vegetation, accidents and infections may result, as well as land degradation which lenders the area unsuitable for other purposes. There is need for intervention to achieve sustainable mining. The findings were used to come up with recommendations on vital areas to be reviewed to improve land restoration in artisanal and small-scale mining in Malawi.

ACKNOWLEDGEMENTS

I am grateful to all those who have been of great assistance to me in this project. There were times when I felt discouraged but MR. Josiya, my supervisor, always guided and encouraged me to keep going. I also had a lot of assistance from Mr. Chikomeni Manda who helped me with locating suitable participants in the study area; and Bright Manda who shared with me a lot of information and took me around to different mine sites. I am also thankful to my family and friends including Esau Kawonga, Clinton Kacheche, and Ellanive Jelenje who kept me motivated to work on the project as well as all 2017 Earth sciences students for their respective contributions and support.

Finally, and above all, I glorify the Lord Almighty for making this whole project a great success.

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ACRONYMS/ABBREVIATIONS

ASM: Artisanal and Small-scale Mining

CEPA: Center for Environment Management Act and Advocacy

EMA: Environment Management Act

GAM: Gemstones Association of Malawi

GPS: Geographical positioning Systems

GSD: Geological Survey Department

LSM: Large Scale Mining

MAWIMA: Malawi Women in Mining Association

MMA: Mines and Minerals Act

NCA: Norwegian Church Aid

NWDP: National Water Development Project

PPII: Personally Protected Identifiable Information

SADC: Southern African Development Corporation

SPSS: Statistical Package for Social Sciences

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1 CHAPTER 1: INTRODUCTION

1.1 Background

Malawi has a variety of mineral resources, a good number of which are being exploited by the Artisanal and Small-scale Mining (ASM) sector; including gemstones, gold, construction and industrial materials among others, (Ministry of Natural Resources & Energy and Mining, 2013). Artisanal mining broadly speaking, refers to mining by people, or cooperatives with stripped down mechanization, usually within the informal sector of the market (Hentschel et al. 2002). Small-scale mining is basically a poverty driven activity, usually practiced within the poorest and most remote rural areas by for the most part itinerant, poorly educated people with few employment alternatives. (World Bank Group, 2001). In Malawi, the ASM sector employs somewhere between 13,500 (NCA, ActionAid & CEPA, 2014) and 40,000 (Buxton, 2013) people. More Malawians are employed in ASM than the large-scale mining (LSM) sector and therefore ASM is of importance from a socio-economic perspective, (Phoya, 2015).

Artisanal and Small-Scale Mining activities in Malawi have grown considerably in recent years and has attracted great attention. ASM has the potential to limit rural-urban migration and stimulate local processing and manufacturing industries. These encourage local entrepreneurship thereby creating employment and contributing to poverty reduction, (Ministry of Energy and Mines, 2007).

However, there is a down side. Among others, ASM is frequently associated with environmental degradation (Veiga, 2014). As the mineral sector grows, there is more recognition of the importance of protecting the environment as well as communities around mines. To ensure environmental sustainability, mining rehabilitation which is the process of repairing the damage done by mining activities is required. There is need for scientific information on land rehabilitation as a basis for ensuring environmental management in ASM in Malawi.

1.2 Problem statement

In Malawi, mining is considered an emerging and important sector but the potential negative effects have been noted (Ministry of Natural Resources & Energy and Mining, 2013). According to a study in South Africa by Heath, (2006), environmental degradation footprints of many areas mined a century ago are still prevalent. This shows that the resulting impacts are seldom self-limiting, unless appropriate interventions such as rehabilitation become implemented. However, most attention is given to the large scale sector. Currently, there are growing environmental concerns arising from ASM activities, yet most projects in ASM focus on the socioeconomic and marketing aspects.

Considering the scale at which artisanal mining is growing in Malawi, and that mineral resources are non-replenishing, over time a great area of land will get excavated; rendering it less productive for other uses if not restored. In Malawi, the major source of income for most households is farming. Thus, degradation of land resulting from small scale mining over time, may affect the socioeconomic status of most rural households due to loss of agricultural land. This being the case, the need for environmental sustainability cannot be taken lightly. It is to this regard that the researcher intends to assess the gap on land rehabilitation in ASM after mining.

1.3 Main and specific objectives

The main objective of this study was to assess the impacts of lack of land rehabilitation in ASM on the environment in Mzimba. Other specific objectives include:

- To identify key barriers to land rehabilitation in ASM
- To assess the current monitoring of ASM in terms of land during operations.
- To determine perception and knowledge of small scale miners in Mzimba on mining legislation.

1.4 Research questions

The major question to be answered in this research is, "how does lack of land rehabilitation in ASM affect environmental sustainability?" specific questions include;

- What are the major impacts of lack of land rehabilitation on the environment?
- What are the major barriers to land rehabilitation in ASM?
- How effective are monitoring and mining policies on promoting environmental rehabilitation in ASM?

1.5 Significance of the study

Although the rapid expansion of the small-scale mining industry has contributed positively to the socioeconomic fabrics of a number of African countries, a wide range of environmental complications has accompanied this growth. The individual impact of each small alluvial mining is usually not great but the combined effects of numerous operations over time may be disastrous to the environment, (Hilson, 2002). This research will help to identify critical environmental problems resulting from lack of land rehabilitation in ASM; as well as discover major setbacks to land rehabilitation requirements. This will assist in making effective related decisions.

Significantly, the study contributes important scientific data that supports the attainment of the United Nations Sustainable Development Goal number 15; to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation.

Furthermore, the study will be useful in bridging the information gap needed in addressing land rehabilitation issues; since, unlike in large scale sector, little is documented of land rehabilitation in ASM in Malawi.

2 CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Artisanal and small scale mining is largely practiced in developing countries including Malawi. Several studies have been conducted to assess the impact of ASM on the environment. Lack of land rehabilitation in particular, may bring about negative effects on land and its use. The following studies have been in review to find out what has been written on land rehabilitation in the ASM sector.

2.2 Impacts of ASM on the environment

In most of the SADC countries including Malawi, mining is the only known economic alternative to agriculture. Unfortunately, small-scale mining activities are usually conducted without any planning and are undertaken by workers who lack technical skills and knowledge since most of them are uneducated, and focus more on short term benefits than long term consequences. Due to this, Artisanal and small-scale mining is associated with a number of negative impacts including, environmental, social, as well as health and safety.

Environmental impacts include deforestation and land degradation, mercury pollution, dust and noise pollution, (Funoh, 2014). The primary impact; land degradation, is a common issue at several illegal and unmonitored ASM sites. Generally, the industry features poor working conditions and its workers have low environmental awareness and totally disregard key issues of health and safety, (Ghose, 2002). Due to non-management, the negative impacts associated with ASM in remote areas is even worse. (Goncalves, 2016).

According to a study conducted in South Africa by Health, et al (2004), Most of the small-scale miners have a sense that the environment can be impacted by their mining operations but they are vague about it and knowledge of exactly what the impacts may be or how these impacts occur, is superficial. It was seen that both miners and communities do not have adequate knowledge of the impact of mining on environmental parameters. This

level of environmental knowledge could have a correlation with mining practices and real impacts.

2.3 Land rehabilitation activities

In New Guinea, in places where intensive mining activity has occurred for many years such as Eddie Creek and the Nami area in Wau, landscapes are completely potholed and covered in waste, although some rehabilitation attempts have been made by certain mining companies, (Crispin, 2002). The results of a study by Dreschler, (2002), conducted in the SADC region shows that in gemstone production weathered rock and soil are merely pushed aside. Limestone generates topsoil and poor quality stones as wastes. Ceramic clays generates soil and other unwanted soil as waste. This can be disposed of around the mining space.

Miners leave behind "moonlike" landscapes consisting of unstable piles of waste, abandoned excavations and vast stretches of barren land. Excavated pits are typically left unfilled and abandoned (Arye et al, 2003). Hilson, (2002) observed that thousands of pits and trenches have been dug in the process of excavating for prospective ore bodies.

Results from a study conducted in Cameroon by Funoh, (2014) showed that mining was observed to have negative impacts on the environment by a minority of miners. The majority (75%) of miners interviewed reported that mining never had any negative effects on the environment while 25% of them cited impacts like open mines and deforestation. While ASM activities may seem to not have immediate effects, their effects may be profound in an extended period of time.

In Malawi, as indicated in the draft ASM policy, upon completion of mineral extraction, ASM operators are required to rehabilitate their mined out areas. The rehabilitation is aimed at restoring the environment as close to its original state. Since land rehabilitation was observed to be a challenge, it was stated that the government will enforce proper decommissioning and rehabilitation of mined out areas. Kapokosa (2018) conducted a similar study, however, the study only covered large scale licences but not mining claims.

The number of small-scale licences is increasing, and they are not monitored as much as the large-scale licences. Therefore, a study specifically targeting them can help narrow this gap.

2.4 Awareness of miners regarding ASM laws and regulations

Legislative instruments for the mineral and mining sector in Malawi are administered by the Mining Department in association with the Geological Survey Department. The main focus for the Geological Survey Department, however, is exploration. The Mining Department is responsible for the processing of all applications for mining and subsequently licensing them. It additionally guides miners on acceptable mining stretegies. In addition, the department is accountable for scrutiny of technology and safety. The Mining Department liaises with the Department of Environmental Affairs in evaluating EIAs specific to the mining sector, (Tychsen, 2018).

The majority of artisanal and small-scale mining activities operate informally, despite the existence of legal frameworks for ASM in many countries around the world. A large proportion of small-scale miners are ignorant of the laws governing mining activities and the environment. According to Heath, (2006), communities living in close proximity to small-scale mining operations are aware of issues such as rehabilitation and environmental impacts associated with mining activities; environmental issues and impacts were largely ignored by the miners; the required mining legislative documentation were seen as a "license to mine only" and were largely not consulted further for rehabilitation and closure.

Illegal mining has become a serious drawback and is on peaking in a number of the provinces of South Africa. These illicit mining activities in the old, defunct mines have, within the past two years, become a serious challenge for the Department of Mineral Resources, mining firms as well as local authorities, (Hutchings & Mkhize, 2014). The lack of policies and socioeconomic incentives for miners, such as granting permits and licences to operate, is still a challenge for the local governments, especially in lesser-developed countries (Adrian, 2016). The illegality of ASM makes it difficult to monitor and control.

The government of Malawi has so far come up with related documents such as the 2019 Mines and Minerals Act, Environment Management Act and the ASM Policy. According to the Environment Management Act (2017), every one shall take all necessary and acceptable measures to protect and manage the environment, to conserve natural resources and to promote their sustainable utilization. The policy statement says that the policy will support the provision of training in environmental management; and the government will facilitate monitoring and enforcement of compliance of mining environmental standards in ASM. The Malawian government has also encouraged small-scale mining operators to be licensed in order that they may operate legally. This has helped the government to monitor the sector and to provide the operators with proper mining techniques (Malunga and Phalira, 2015). The paramount goal is to ensure that ASM operators are able to restore mining areas to their near original status upon closure of activities. However, little is documented on the same.

Most of these studies were conducted in other countries. In addition, they were broad studies that encompassed all processes during mining; that is, exploration, extraction and closure. This research therefore aims at assessing the situation in Malawi, particularly Mzimba; focusing on mine closure and to generate additional related information vital for decision making.

3 CHAPTER 3: METHODOLOGY

3.1 Research design

This study used the mixed design that include both qualitative and quantitative methods. Qualitative means were mainly used to collect data. In particular; survey, observation and desktop study were used. The survey method involved questionnaire and interviews. Desktop study was used to collate recorded data. The collected data was quantitatively analyzed.

3.1.1 Study Area

The study was conducted in Traditional Authority Mzikubola in Mzimba district. Mzimba district is in the Northern region of Malawi, latitude of 11.8992^0 S and longitude of 33.5924^0 E. It covers an area of 10,430km ^{2}. The areas of study include Majiyasawa forest, Perekezi forest, chanunkha Shaba village, and Bulukutu village where Artisanal and small scale mining for gemstones is taking place. Mzimba district was selected for the study because artisanal and small scale mining has been happening as far back as early nineteen nineties; thus, it is long enough to have a measurable impact on the environment.

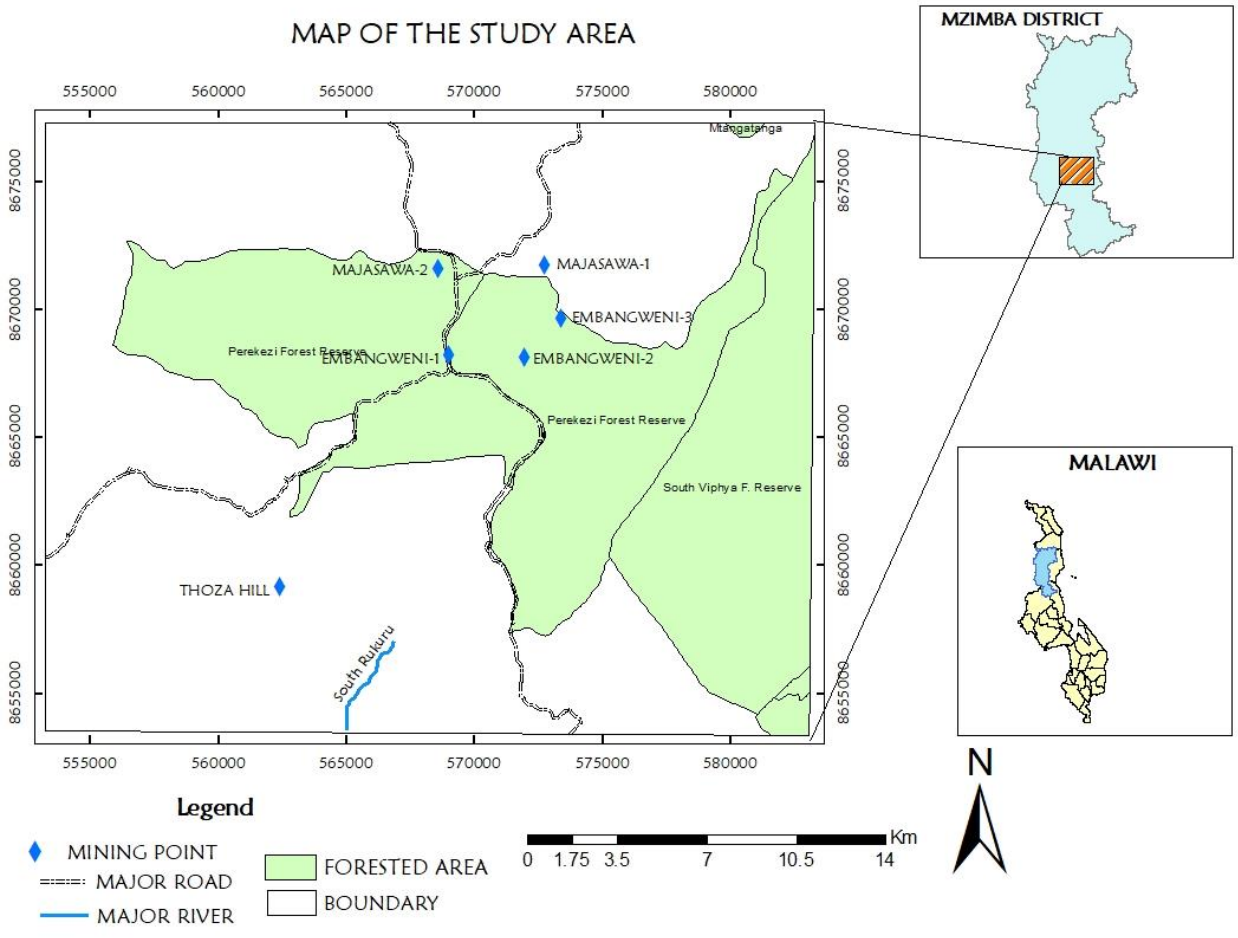


Figure 1. Map of Malawi showing location of the study area; TA Mzikubola, Mzimba district

Topography and Geology

The area falls naturally into five topographical units; the Upper South Rukuru Valley, the Central Mzimba Hills, the Upper Kasitu Valley, the Viphya Plateau and the East Viphya Scarp zone. There are three distinct drainage basins which include the South Rukuru, the Kasitu and the Luweya basin, (Gaskell, 1973). Generally, Mzimba is covered with medium to light textured but moderately fertile soils with eutric-fersialic soil characteristics. The soils have moderate to good drainage. Fertile soils are found in the valleys and are suitable for agricultural production (NWDP, 2011).

The lithology of TA Mzikubola in mainly gneiss with varying major minerals such as biotite, muscovite, silimanite, quartz and feldspar. Others common rocks include quartzite, chanockitic granulite and schist. Gemstones hosted mainly in pegmatites include rose quartz, clear quartz, ruby, sapphire, tourmaline, aquamarine, and rhodolite.

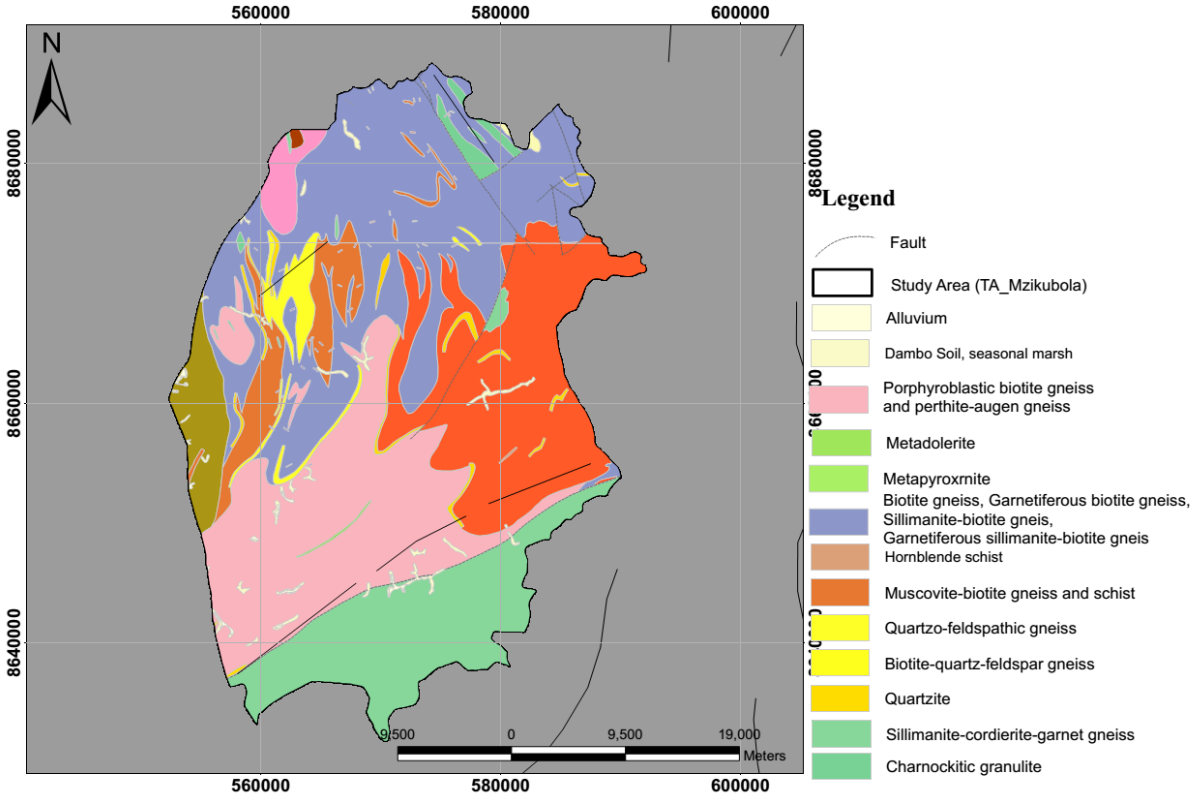


Figure 2. Geological map of TA Mzikubola, Mzimba district.

3.1.2 Sampling and sample sizes

The study population was people in Mzimba district specifically in Traditional Authority Mzikubola that participate in small scale mining or live close to the mines. This survey was conducted in person and the participants were recruited using the purposive sampling method in order to include only those that ever participated in ASM activities or lived close to the mines. This was done with an aim to have participants that would provide relevant data for the study. The study sample size was 35 participants of which 22 were males while 13 were females. Only one female was a miner, the rest were community members. The respondents include 15 community members, 10 mine owners and 10 mine workers respectively. To minimize bias all respondents replied to the same questions.

3.2 Materials and Methods

The assessment relied on literature review, questionnaire and field assessment. The literature review included laws, regulation and guidelines from Malawi. Some selected Environmental Impact Assessments reports by other researchers were also studied. The field trip to Mzimba was conducted from 26th to 30th July 2021.

This study used both primary and secondary data. Primary data was collected from artisanal and small scale miners, traditional leaders, and ASM leaders using questionnaires and interviews. Field observation was also conducted.

3.2.1 Desktop survey

The first component of data collection involved review of secondary data. Fundamental sources included; the Mines and Minerals Act 2019, the Environment Management Act 2017 and ASM policy 2015. These were thoroughly reviewed to determine the nature of regulations related to ASM with emphasis on land rehabilitation and environmental sustainability. This also helped in designing the relevant questions for the questionnaire in order to compare and contrast documented work with activities on the ground. Literature

review of other published and unpublished literatures including books, articles, reports, journals related to the topic of study was also done in order to analyze the compiled work by other researchers and scientists.

3.2.2 Questionnaire development

The main survey instrument was the quasi-structured questionnaire. The questionnaire was used to gather data in situations where direct observation was not appropriate or feasible. Most questions were closed and had a rating scale. This was done to ensure easy conversion of data from qualitative to quantitative during analysis. A few questions were open ended to enable participants to express freely issues which were otherwise not specific and likely to vary among participants. The questionnaire encompassed areas such as existence of negative impacts of lack of land rehabilitation, people's perception on land rehabilitation, knowledge of the related laws and policies, as well as tracing monitoring activities by regulatory bodies.

3.2.3 Direct interview

The semi-structured interviews were used in order to aid in clarity on the gathered information and significantly help to get more detailed and context related information. Interviews involved traditional leaders, and local ASM leaders.

3.2.4 Field observation and measurements

Field observation was used to assess the nature and scale of land rehabilitation as well as extent of environmental damage resulting from lack of land rehabilitation. The length, and depth of mine pits were measured using a string and then compared on the tape measure. The GPS was used to map the distribution of specific mining sites as well as for estimation of the total surface area affected by the mine.

3.3 Data management

The data was recorded using audio-visual recordings and note-taking. Main languages used in the whole process of data collection were Tumbuka and Chichewa languages. To ensure privacy and confidentiality, protected personally identifiable information (PPII) was

replaced with research identification codes. Electronic data was stored in password protected computers. Computerized data was disposed of by permanently deleting, while paper records were destroyed by burning.

3.4 Data analysis

The field assessments and interviews were used to establish exactly what is happening on the ground compared to what is written in documents and see if the practices and standards are effective. The major technique of data analysis was descriptive analysis. Data analysis was done in three phases; data entry, analysis and correction.

Quantitative method was used to analyze questionnaire data. Qualitative data was converted to quantitative data. That is, data from questionnaires, was identified by numbering the questionnaires, classified by creating a code book, and assigned a numeric value to define the variables for easy analysis. The data was entered in SPSS program version 20 for descriptive analysis. Graphs, tables and other statistical tools were used for data analysis and interpretation. The data was also checked for missing data and outliers.

Qualitative method was used to analyze data from literature reviews and interviews. The data collected from the interviews and available literature was coded and summarized in order to give information that relate to the objective of the study.

The main parameters which were derived from the analysis of the data include impacts of lack of land rehabilitation, barriers to land rehabilitation, effectiveness of monitoring, and knowledge and perception on land rehabilitation. Finally, recommendations were made based on the evidence found during this assessment.

4 CHAPTER 4: RESULTS AND DISCUSSION

4.1 Results

The results for the data from questionnaire are summarized using descriptive statistics in the tables and graphs below.

Table 1. showing some mine location and the size of the areas affected

Point	Area	Coordinates	Depth (m)	Perimeter (m)	Area (m^2)
MP 1	Chanunkha Shaba	11° 52' 28.58''S 33° 33' 18.24''E	30m	302m	4,894.4m^2
MP 2	Chanunkha Shaba	11° 51' 34.02''S 33° 33' 22.24''E	12m	134m	1,094.4m^2
MP 3	Majiyasawa	12° 0' 20.17''S 33° 38' 12.50''E	29m	375m	5,054m^2
MP 4	Majiyasawa	12° 0' 24.60''S 33° 37' 57.05'' E	14m	297m	3,505m^2
MP 5	Bulukutu village	12° 0' 33.59''S 33° 33' 11.17'' E	7m	104m	988m^2
MP 6	Embagweni turn-off	12° 2' 35.50''S 33° 38' 17.26'' E	21m	396m	8,813m^2
MP 7	Embagweni turn-off	12° 2' 26.98''S 33° 38' 58.69'' E	36m	275m	5,762m^2
MP 8	Embagweni turn-off	12° 2' 15.37''S 33° 39' 5.37'' E	23	633m	12,875m^2
MP 9	Thoza	12° 7' 0.13''S 33° 34' 59.17'' E	32m	618m	19,440m^2

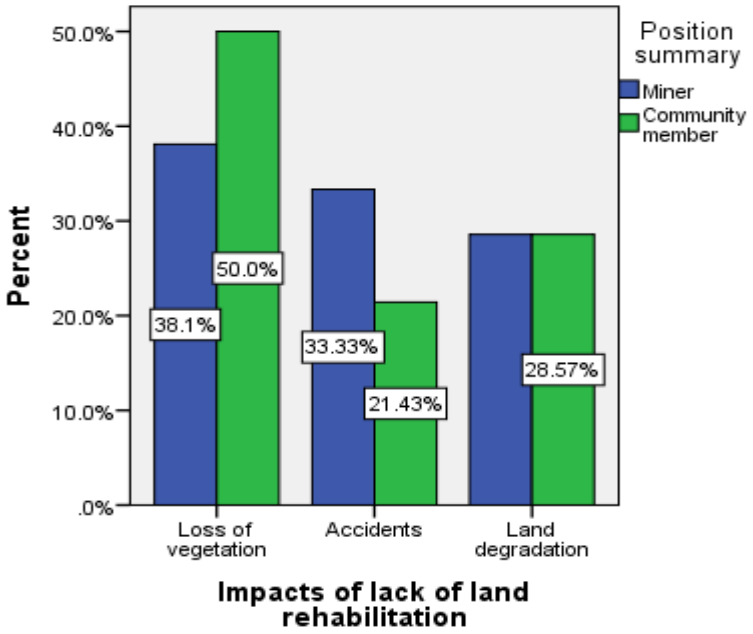


Figure 3.Graph showing the major impacts that result from lack of land rehabilitation; clustered based on whether the respondent participates in mining or is a community member.

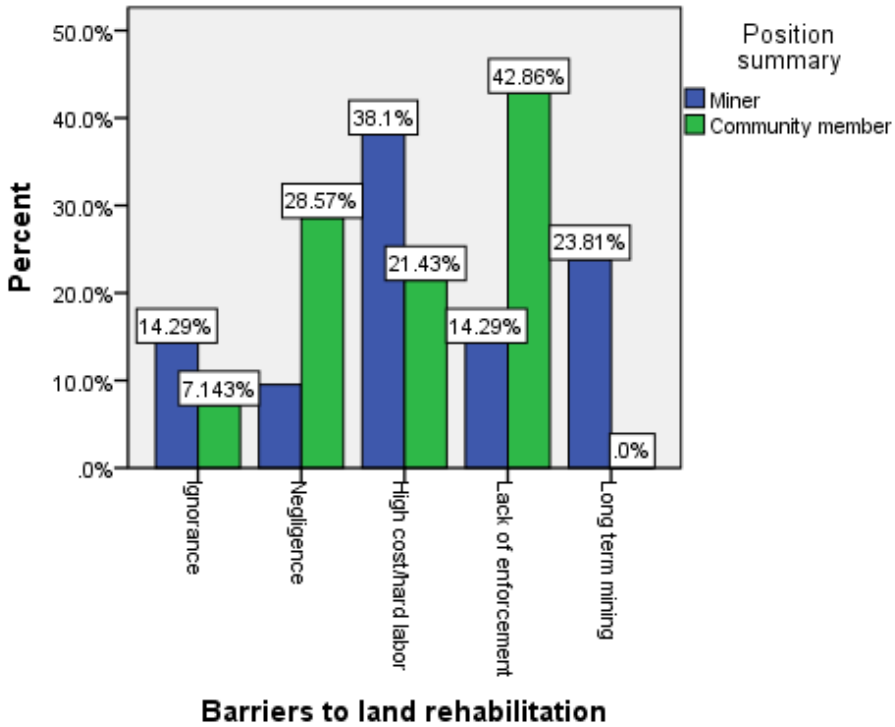


Figure 4. Showing barriers to land rehabilitation

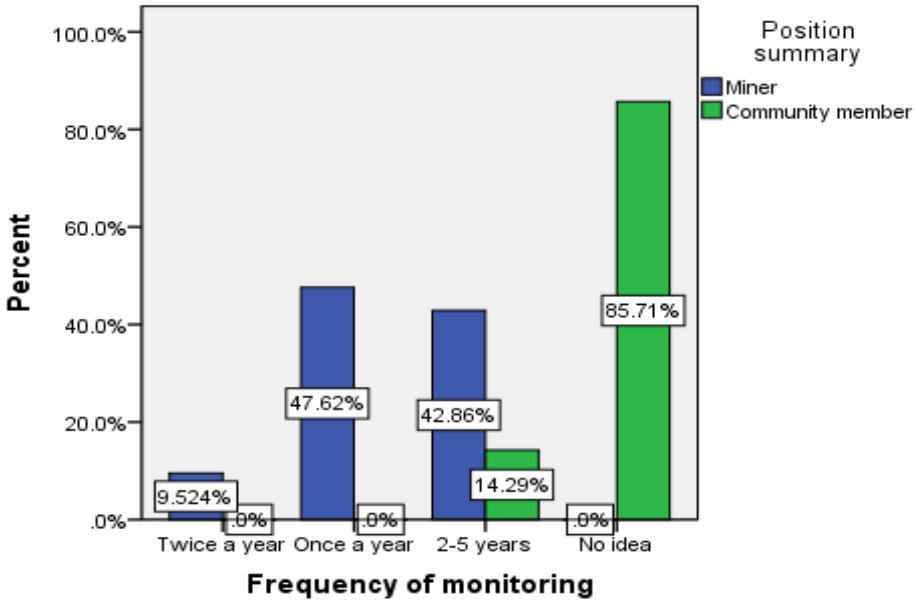


Figure 5. Graph showing the frequency at which monitoring and supervision is done.

Community members did not contribute to this kind of data, since they would not actually know when the supervisors visit.

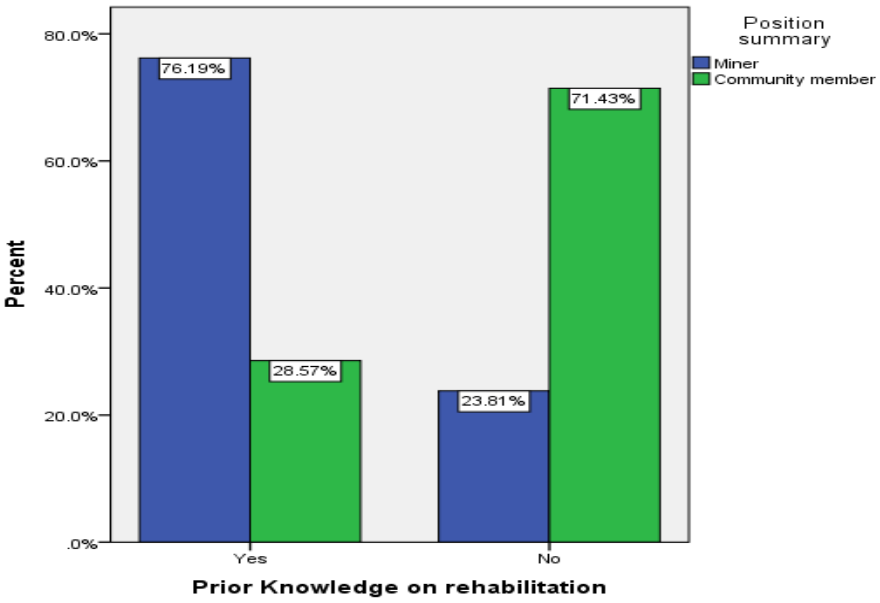


Figure 6. Graph showing prior knowledge of the participants on land rehabilitation clustered based on whether the respondent participates in mining at any level or is a community member.

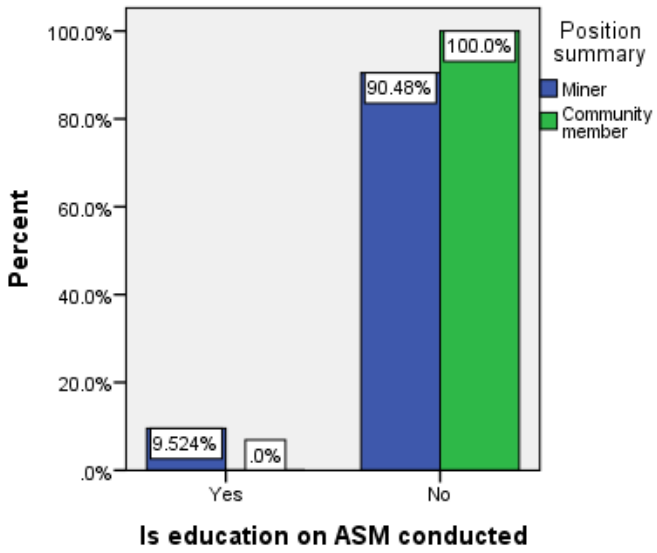


Figure 7. Showing results on assessment of conduction of education training regarding ASM and the environment.

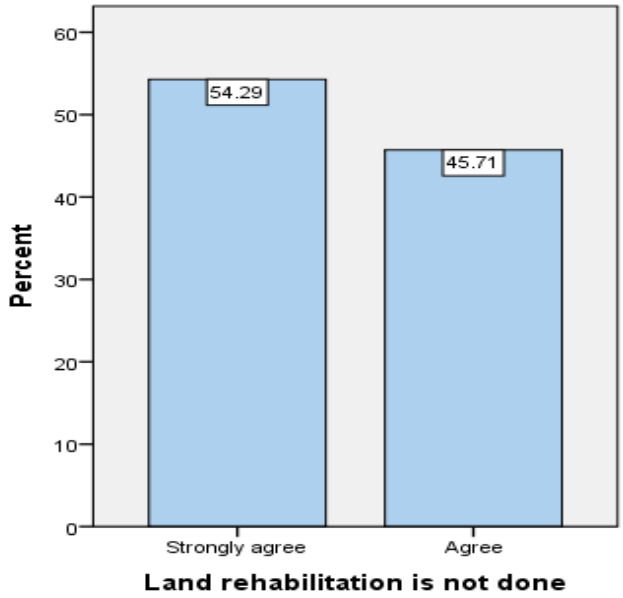


Figure 8. Showing respondents' responses on whether land rehabilitation is done in Mzimba or not.

The graph shows only the results of those that agree that rehabilitation is not done. Among those interviewed, no one gave a response that land rehabilitation is done.

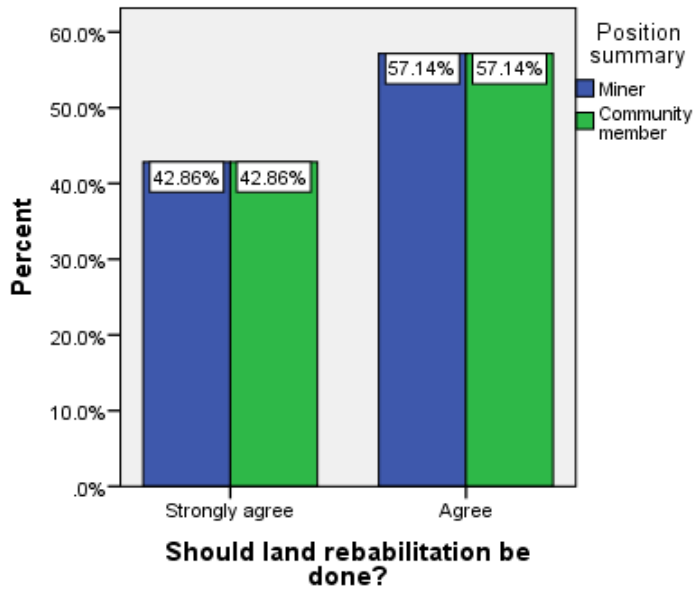


Figure 9. Graph showing respondents' views on whether land rehabilitation should be done. None of the respondents disagreed to the question.

4.2 Discussion

The first thing to consider for this report is whether land rehabilitation is a vital factor in the success of environmental sustainability. Based on the findings from desktop study, land rehabilitation is considered vital to success. The study showed that people working in ASM in Mzimba district also consider it vital and as such, it is worthy studying it and finding ways of improving its implementation.

4.2.1 Impacts of lack of land rehabilitation in ASM

The results of the field study have shown that artisanal mining operations in Mzimba district have worsened the physical environmental impact.

The main environmental degradants of gemstone mining comprise of several mine pit excavations of which a large proportion are inactive and have not been refilled causing massive destruction of land. The pits can be as deep as 36 metres, in some cases more. Furthermore, no protection is provided to both active and inactive mine pits. Along with this are large stockpiles of excavated materials, which have been left around the mine pits.

The land is not properly restored to enable other economic activities once the gemstones have been depleted or abandoned due to other reasons. The pits also result in the loss of agricultural land. In addition, the large number of pits pose a safety hazard for both people and animals.

Loss of vegetation

ASM activities usuaally focus on near surface mineral deposits and mining laterally and therefore affecting large areas. For example, in Thoza a great area has been affected by deforestation. Miners rampantly cut down trees as they follow bands which they think have high potential for gemstones. Furthermore, some mines are located in forested areas such as Perekezi forest. Trees are cut down to create space for the pit, as well as roads. In addition, a mine can have as many as 30 workers. These people have to construct temporary dwelling structures, toilets and bathrooms. They also have to use wood for fire. All these involve use of trees and since a mine can remain productive for several years, the resulting effect on vegetation becomes huge. In addition, minerals are non-replenishing, therefore, miners have to move from one area to the other and make a new opening.

Furthermore, during extraction, mining leads to overturning of soil where top soil goes to the bottom and subsoil on top. This renders the soil infertile for plant growth since the subsoil hardly contains necessary nutrients. This turns the mining area into a barren land.

Source of accidents and infections

According to the Mines and Minerals Act (2019), ASM operators are currently subject to simple requirements, such as backfilling and fencing the pit, with the main objective to protect the health and safety of people living in areas surrounding the site. However, in Mzimba this is not done. Abandoned pits act as traps for animals and breeding grounds for mosquitoes. For pits located in forests, there is risk to wild animals. Some mines are close to villages, for example, an abandoned mine in Chanunkha Shaba village is located less than 50 metres from people's residence and approximately 4 metres from a pathway.

Domestic animals may accidentally fall into such pits. Children and drunk people are also at risk especially at night.

These pits also collect water during rainy seasons and act as breeding grounds for mosquitoes as shown in the figure below. Mosquitoes may cause malaria among community members surrounding the mine, thereby affecting the overall health status of the community.



Figure 10. showing a water filled abandoned mine.

Land degradation

One of the main effects of artisanal mining on the environment in Mzimba is soil degradation and land damage. Miners do not refill the pits they make after mining. Gemstones usually occur in pegmatite veins; miners remove top soil and gangue sometimes with use of an excavator. The soil is simply piled up around the mine. The wider and deeper the pit, the great the amount of waste generated. This waste forms anthills around

the pit and thus, a landscape marked with prominent highs and lows. This nature of land becomes unsuitable for other uses



Figure 11. showing land degradation in an abandoned mine in Mzimba district.

4.2.2 Barriers to land rehabilitation

Land rehabilitation is expected to be done after mining from a particular area is finished. In small scale mining, factors for lack of rehabilitation may be related to miners themselves, the governing bodies as well as the nature of the mining activity.

In general, the results as indicated in figure 4 show that high cost or hard labor and lack of enforcement are the main barriers to land rehabilitation carrying 31% and 26% respectively. In particular, high cost is considered to be the leading barrier from the miners' perspective, followed by long term mining period and then lack of enforcement.

Miners said it is hard to rehabilitate the land after mining. This is because with artisanal mining, one is never certain of production. It is done under trial and error. It is possible to mine for several years without finding any gemstone, so, having invested a lot without profit, it becomes hard to rehabilitate the land. While this may be true in some instances, oftentimes even when they manage to find deposits of gemstones, still, they do not rehabilitate the land thereafter. They are only interested in finding the gemstones, not in the condition in which they leave the site after that. In another understanding, the above factor may be regarded as mere excuse; if they are willing to start mining knowing that they may not even recover anything, they should also be willing to do the same with rehabilitation at the end. In fact, land restoration should not depend on whether they recover the gemstones or not. It should be done as long as land has been affected. In addition, according to an interview with one of the Mzimba Gemstones Association representatives, it may also be argued that refilling of the pits is relatively cheaper than digging. It takes relatively longer time to dig than it may take to refill.

Long term mining period appears to be another factor not included in many previous studies. However, according to miners in Mzimba, most mines take several years before the minerals get depleted. One miner may start mining, and then run out of finance along the way, and another miner may take over. For example, a mine in Majiyasawa was opened around nineteen nineties. After such a long time and with a long chain of miners, in the end, the last miner may not fully assume responsibility of the site to conduct rehabilitation.

From the community members' perspective, contrary to that of the miners, lack of enforcement (43%) is assumed to be the leading barrier followed by negligence (29%). While most miners are aware of the need for land rehabilitation, they do not take an active role in fulfilling it. The above two factors are related. Due to poor enforcement by the government, miners also show little regard to land rehabilitation. In addition, by scale of mining, the miners are not required to conduct Environmental and Social Impact

Assessments (ESIA) or to develop Environmental Monitoring Plans (EMP) prior to mining. This also makes miners to pay little attention to rehabilitation after mining is completed since they had no prior plans.

In conclusion, Environmental management is generally weak. Most miners do not have the adequate resources to finance the cost of mine rehabilitation. From another perspective, it can be described as negligence which is also related to poor monitoring and enforcement. Nonetheless, while some factors are considered major contributors, all of the above factors play a particular role to lack of land rehabilitation in ASM. Respective solutions need to be sort to address each factor.

4.2.3 Effectiveness of monitoring and policies on land rehabilitation

Small-scale mining is considered a potentially environmentally degrading activity, that is why it is vital that an effective system of legislation is available for the purpose of environmental regulations. Currently, the mineral sector is governed primarily by the Mines and Mineral Act(MMA), 2019; which mainly covers issues of licensing but also has considerations for safety and the environment. In addition, the sector is covered in the Environmental Management Act (EMA), 2017; that regulates all sectors in Malawi in relation to the environment. The environmental law is a policy instrument designed to manage natural resources intelligently, with a view to moderating their use for sustainability, intergenerational equity and avoidance of irreparable consequences.

The findings show that 47% of all miners and mine workers say that monitoring by the Ministry of Mines and Environmental Department is done at least once every year. On the other hand, about 24 % say it is done at least once every 2 years. This shows that approximately it is done every one to two years. Usually when a team from Ministry of Mines comes to make demarcations for a new mine, they may utilize the opportunity to go around other mines within the vicinity. Even so, this is poor monitoring because

according to the ASM policy, monitoring should be done every month. Inefficient monitoring contributes to lack of compliance in the long run. In addition, based on this method, if no new mine is opened within the area, then supervision or monitoring will not be done for that particular period. There is need for arrangement of visits that will solely be for monitoring and supervision purposes.

According to the ASM Policy (2014), ASM operators are currently only subject to simple requirements, such as backfilling and fencing the pit, with the main objective to protect the health and safety of people living in areas surrounding the site. However, observation on what actually happens on the ground in Mzimba reveals the contrary. Abandoned mines are still not rehabilitated, plus, there is no progressive rehabilitation in those that are still underway. This also shows inadequate monitoring and enforcement. In addition, for any legal mining, representatives from ministry of mines come to assess, demarcate and authorize mining at a particular area. However little can be said of similar acts when the mine is closed. Initiation process is satisfactory but closure process is still ineffective. There is little follow up.

The ASM sector in Mzimba has two main associations operating at national level; the Gemstone Association of Malawi (GAM) and the Malawi Women in Mining Association (MAWIMA). The two associations have been instrumental in lobbying for mining policy and legal reforms to create a conducive mining business environment for ASM operators, create a structured mineral markets and provide access to appropriate mining skills and technology. However, they play no significant role with regards to land rehabilitation.

4.2.4 Respondents' knowledge and perception on land rehabilitation

In the 2014 draft ASM policy, one of the issues is that ASM operators lack appropriate knowledge and training in mining and environmental management which makes their operations environmentally unfriendly. According to this study, about 76% of miners interviewed expressed prior knowledge of the need for land rehabilitation after mining. All respondents agreed that land rehabilitation should be done. This shows that miners and

the communities surrounding mines are aware of the gap on land rehabilitation. They expressed a positive perception towards who should rehabilitate the land. All respondents said it is the duty of the miners to rehabilitate the land after completion of a mining activity. This agrees with data from figure 4 which shows that ignorance is the least of the barriers to land rehabilitation accounting for only 11 percent.

This data also disagrees with most studies that indicate that artisanal and small scale miners are not aware of the need for rehabilitation. These artisanal and small-scale miners may not be educated, but they have necessary basic knowledge with regards to environmental safeguards. Therefore, their inability to carry out land rehabilitation can be ascribed to other factors such as negligence or high cost.

4.2.5 Extent of land rehabilitation

ASM activities often focus on near surface deposits working laterally and therefore affecting large areas. In the field it was observed that artisanal and small scale mines are sparsely located. However, individual mines may affect the surrounding areas. For example, as indicated in table 1, a single mine including the pit, and the waste generated may affect an area of up 12,875m^2 and a depth of up to 36m. some mines are as close as 284 meters to each other as is the case at Embangweni turn-off. In other instances, like in Thoza where strip mining takes place, a great area of more than 19,440m^2 is affected. There is fast increase in the area covered compared to open pits where size usually increases exponentially with depth. In Thoza mining is mainly illegal and environmental damage is rapid and unsanctioned.

Out of the 9 mines that were visited, 4 were closed or abandoned mines. all the 4 closed or abandoned mines were not rehabilitated (100%). Those running the pits that are still being mined, expressed no tangible plans or interest in rehabilitating the site after completion of the activity. There is no progressive land restoration on the mined out sites. According to the Mines and Minerals act of 2019 section 189, a mining licence should be

renewed after every 2 years. Before renewal, one of the requirement is that the applicant should give a description on the rehabilitation work done on the mined out areas. Most of the visited mines in Mzimba are more than 10 years old, yet there is no evidence of progressive land restoration. This shows poor enforcement of the laws during licence renewal. In addition, both the community members and the miners were unable to trace any closed mine that has been rehabilitated so far in the study area. This shows that in Mzimba, there is still a huge gap on implementation of land rehabilitation in the ASM sector.

An artisanal one-man operation compared to a more mechanized approach has less of an impact on the environment; however, if many artisanal small-scale mines are operating in a small surface area, their impacts cumulatively have a significant negative impact on the environment. For instance, if these mines were in one area, they would cover a total area of approximately 58,425m^2. The actual area affected is greater than the one approximated in this study since there are tens of mines within Mzimba district that were not visited because of inability to manage transport costs.

5 CHAPTER 5: CONCLUSION

The overall aim of this study was to determine impacts of lack of land rehabilitation in ASM in Mzimba district. Data collection methods such as survey, field observation and measurements were conducted to achieve the study objectives.

This study revealed that ASM operators have exacerbated the environmental problems. Environmental sustainability particularly land use is at stake. Land rehabilitation is not actually done, however, there is an understanding of the importance of conducting it at the end of the mining project. There is inadequate monitoring and enforcement of mining

environmental standards in the sector. The ASM operators have no financial resources to rehabilitate mined out areas or are negligent on the activity.

This article found that there is an urgent need for the implementation of abandoned mines rehabilitation strategies that will put an end to both physical and environmental hazards. The strategies should be those that open new economic opportunities for the host communities. To have substantiality and acceptability in the mining sector, land must be repaired as much as possible and as soon as possible with the aim of returning it to the original and stable state.

It is hoped that this study will initiate a constructive discussion between the stakeholders and lead to a situation where mining is no longer viewed as a temporary benefit with permanent destruction. This can in turn lead to more acceptance of mining and maximization of its benefits for the adjacent communities, the environment and the whole nation.

Small-scale mining activities have the ability to significantly change the physical landscape. It is therefore crucial to increase awareness of environmental issues, particularly damage to soil and vegetation.

6 CHAPTER 6: RECOMMENDATIONS

Based on the findings and in consideration of achieving best practices in land rehabilitation in Malawi's mineral sector, some recommendations are given below.

- Government should develop personnel capacity in the areas of mining and geological survey and environmental department so that more qualified people are available for extension work, civic education, land rehabilitation and other related ASM activities.

- Progressive rehabilitation should be made mandatory and miners must make reports on how much they are rehabilitating instead of leaving everything to the end.
- The government must establish and uphold code of practice for land restoration in Malawi peculiar to Artisanal and Small-scale Mining.
- The government must clearly define standard depth of pits in small scale mining. While the maximum size is 2 hectares, it is not clear as to how deep small scale mines may go.
- On the issue of training in land restoration, government can conduct training workshops or use other means of providing training to miners. Given the scattered and informal nature of much of this activity, the government is unlikely to be able to raise standards simply through legislation. A more realistic approach is to raise awareness of the risks.
- There in need for the establishment of proper handover of mines which should also clearly consider responsibility for land rehabilitation.
- Research institutions should increasingly focus on the development and implementation of viable solutions to the well-documented problems in ASM.
- The assessment was only done in one traditional authority and in gemstone mining alone. There is need for a national level assessment that will include other sections of ASM.

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8 APPENDICES

Appendix 1: Survey data collection instrument

ASSESSING LAND RECLAMATION IN ARTISANAL AND SMALL-SCALE MINING: THE MZIMBA CASE.

Questionnaire

Ask participants questions and check against a corresponding box.

Participant number: _____

1. Gender female ☐ male ☐
2. Age range: 18-27 ☐ 28-37 ☐ 38-47 ☐ 48+ ☐
3. Level of education

   Primary ☐ Secondary ☐ Tertiary ☐
4. Have you ever taken part in any mining activity? Yes ☐ No ☐
5. If yes, what was(is) your position?

   ☐ Mine worker

   ☐ Unlicensed miner

   ☐ License holder

   ☐ Broker) (Middle man)

   ☐ Other (specify) _____

6. Have you ever heard of the need for land rehabilitation after mining is finished?

   Yes ☐ No ☐

   (If 'no,' explain it to the participant then proceed to the next question)

7. To what degree do you agree with this statement: land rehabilitation is not done after mining?

   Strongly agree☐ Agree ☐ Disagree ☐ Strongly disagree ☐

8. What are some of the negative impacts of lack of land rehabilitation after mining?

   ☐ _____

   ☐_____

   ☐_____

   ☐_____

9. To what degree do you agree with this statement: land rehabilitation (filling up of pits and trenches) should be done after mining

   Strongly agree ☐ agree ☐ disagree ☐ strongly disagree ☐

10. Is it possible to achieve land rehabilitation after mining is finished?

    It is possible ☐ it is not possible ☐ not sure ☐

11. Whose responsibility is it to rehabilitate the land after mining?

    The Miners ☐ The Government ☐

    If others, specify _____

12. Do know any old mines that have been rehabilitated

    Yes ☐ No ☐

If 'yes,' how many? _____

13. In your understanding; why is land rehabilitation not practiced?

Ignorance ☐ negligence ☐ high cost /hard labor ☐ lack of enforcement☐

If other reasons, specify:

_____

14. Have you ever participated in any education training on ASM or heard of it taking place around here?

Yes ☐ No ☐

If 'yes,' when? (year) _____

15. How often do ASM supervisors come for monitoring mining activities

Every month ☐ Every 6 months ☐ Once a year ☐

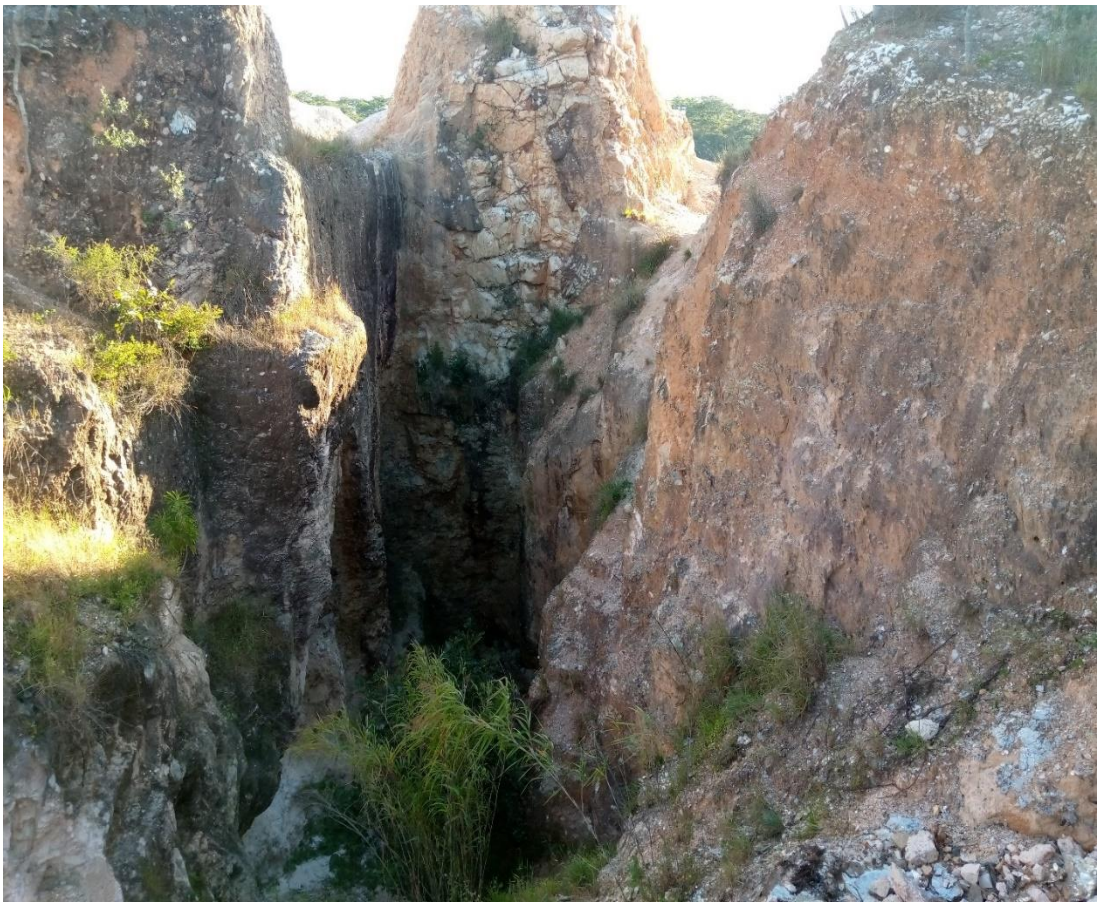
Once in 2- 5 years ☐ Once in 6-10 years ☐

16. What do you think should be done to achieve land rehabilitation?

17. Is there any other related information you would like to share with me today?

End of questionnaire. Thank you for your participation

Appendix 2: An abandoned mine in Mzimba district, Malawi.



Appendix 3: Inside an abandoned mine in Mzimba district

