SAND MINING, LAND DEGRADATION AND REHABILITATION IN RURAL AREAS OF SOUTH AFRICA: A CASE OF MENTZ VILLAGE, LIMPOPO PROVINCE

by

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DECLARATION

I, Dineo Sarah Malebana declare that the dissertation titled **"Sand mining, land degradation and rehabilitation in rural areas of South Africa: A case study of Mentz village"** hereby submitted to the University of Limpopo, for the degree of Master of Development Studies in Planning and Management has not previously been submitted by me for a degree at the University of Limpopo or any other university. That is my work in plan and accomplishment, and that all the materials contained therein have been thoroughly acknowledged.

_____ _____

Signature **Date**

DEDICATION

This study is dedicated to my late father Medupi Peter Malebana who always wished that I could be successful in all that I do. I am where I am due to his hard labour in making sure that I go to school no matter how difficult it was for him. This study is also dedicated to my mother, Maite Clarah Malebana and my family. I have reached this far because of their love and full support through the difficulties of the study.

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ABSTRACT

Sand mining has grown popular in South African rural communities due to its increasing demand for building purposes in and around the surrounding villages as well as a source of income to the rural communities. Sand is an indispensable natural resource of any society around the world. For instance, the government has to deal with the frequent sand mining environmental effects and implement various strategies on how to deal with these effects to protect the environment. Although the National Environmental Management Act (NEMA) 107 of 1998 regulates sand mining, the illegal and unregulated rural sand mining is causing land degradation, creating unpleasant appearances, causing vulnerability to floods and pointing out the need for rehabilitation. Given the circumstances surrounding the issue of illegal sand mining in rural communities, this research is aimed at investigating the impact of illegal or legal sand mining on the environment looking at the land degradation and the importance of rehabilitating the area after use in Mentz village.

The main objective of this research was to explore how sand mining causes land degradation and examining the significance of rehabilitation in sand mining. The methodology of the study was carried out using both quantitative and qualitative research design in a form of questionnaire surveys, oral interviews and field observations to collect the data. The sample was composed of the general members of the community, the chief and the sand miners. For data analysis, the study used the Statistical Package for the Social Sciences (SPSS), IBM SPSS Statistics 25. The results indicated that sand mining causes 54.76% of the land degradation in South Africa. Furthermore, the research revealed that 30.95% of the land degradation was due to deforestation and 11.90% of Mentz land degradation was caused by overgrazing. Besides, an overwhelming 76.58% of the respondents agreed that land should be rehabilitated after sand mining processes.

Keywords: Sand mining, rehabilitation, environment, land degradation

LIST OF ABBREVIATIONS

ANC:	African National Congress
DA:	Democratic Alliance
DEA:	Department of Environmental Affairs
DMR:	Department of Mineral Resources
DWA:	Department of Water Affairs
EIA:	Environmental Impact Assessment
EMA:	Environmental Management Agency
EMP:	Environmental Management Plan
FAO:	Food and Agricultural Organizations
ITB:	Ingonyama Trust Board
MEC:	Member of the Executive Council
NEMA:	National Environmental Management Act
NWA:	National Water Act
SA:	South Africa
SAIIA:	South African Institute of International Affairs
SEMAs:	Specific Environmental Management Acts
SESA:	State of the Environment South Africa
TKAG:	Treasure Karoo Action Group
TREC:	Turfloop Research Ethics Committee
UNFCCC:	United Nations Convention on Climate Change
USA:	United States of America

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CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 Introduction and rationale of the study

The aim of the study was to investigate the impact of sand mining on land degradation and the significance of rehabilitation in Mentz Village. Sand mining is considered to be one of the severe environmental problems that South Africa faces (Chevallier, 2014; Pieterse, 2017). This is comprehensible because sand mining projects or activities are one of the factors that have an impact on the environment towards land degradation. The next section provides the background and rationale to the study and delves into the problem statement to highlight the problem prompting this study. The researcher adopted the appropriate research design, which will be discussed in detail in the research methodology chapter. Lastly, this chapter presents the research ethics, limitations, summary and chapter outline.

Sand mining is the extraction of sand, mainly through an open pit but sometimes mined from beaches and inland dunes or dredged from ocean and riverbeds. Sand is often used in various structural manufacturing, for instance, making concrete used for construction. This sand and gravel are mined worldwide and account for the largest volume of solid material extracted globally and the highest volume of raw material used on earth after water (about 70-80% of the 50 billion tonnes material mined/year).

The constant replenishment of sediment deposits in riverbeds and estuaries by sediment transport confers a wrong perception that sand is a renewable resource (Saviour, 2012; Graham, 2018). However, since it takes many centuries for sand to form from the weathering of rocks, it is essentially non-renewable and its continued unsustainable extraction from the environment will lead to its exhaustion (Hamann 2012; Kori & Mathada, 2012; Saviour, 2012; Madyise, 2013; Graham, 2018). The most common environmental impact of sand mining is the alteration of land use, most likely from underdeveloped or natural land to mining in the ground as well as land degradation (Barrow, 1999; Kiker, 2000; Kihato 2013). Saviour (2012) and Kihato (2013) refer to sand mining as an attempt to meet the basic needs of the growing population through the exploitation of natural resources for economic development, protecting the natural resources and leaving masses of people in abject poverty

including striking a balance between economic development and protection of the environment.

Sand mining is a worldwide activity in both developed and developing countries. According to Kiker (2000) and Vopel, Pook, Wilson & Robertson (2017), these are some of the continuing debates in the international space that researchers, economists, environmentalists, legislatures, governments, civil society, developed and developing countries are grappling with. The demand for sand is growing because of its importance and role in construction (Hamann, 2012; Kori and Mathada, 2012; Saviour, 2012; Madyise, 2013; Chevallier, 2014; Pieterse, 2017; Graham, 2018). Many countries like South Africa have moved towards the adoption of a reconciled position of striking a balance between economic development and the protection of the environment for sustainable development. As supported by Guba, Lincoln and Denzin (2011), there are international treaties signed by different continents like the United Nations Convention on Climate Change (UNFCCC), continental and country-specific legislative frameworks as well as regulations with regard to the exploitation of natural resources for economic development.

According to Saviour (2012), environmental management and planning are being inspired by the goal of sustainable development. Principles such as stewardship and prudence imply that environmental planning and management must be progressive, support sustainable development and ensure stewardship (Hamann,2012; Graham, 2018). Environmental management and planning must adopt broader views in policy-making and planning in the integration of different development viewpoints. This practice is becoming an environmental issue as the demand for sand increases in the industry as well as construction. Sand is an important input to the construction industry, especially in developing countries such as South Africa. According to Saviour (2012), permits for mining continue to be granted despite the environmental impact caused by sand mining activities. Hamann (2012) and Graham (2018) states that sand mining is a consumptive use of sand without considering rehabilitation of the environment in that the benefits of sand mining are based on the removal and sale of the sand as a resource.

Madyise (2013) states that the expansion of towns means growth in infrastructure, hence the need for use of various soil components such as river sand and gravel from

various sites of the developmental area. This is also the case in Mentz Village. The rapid infrastructure development in Mentz Village has increased sand mining activities to support infrastructural development. There has been a significant increase in miners, which in a way is resulting in excessive exploitation of sand in rivers and open fields by sand miners. Numerous international research studies were done focusing on the impact of sand mining activities from different disciplines (Aromolaran, 2012). These include disciplines such as environmental management, development and development law, economic development and building environment. It was against this background that the study aimed to investigate the impact of sand mining, land degradation and the importance of rehabilitation in Mentz Village, Limpopo Province.

1.2 Problem statement, purpose and questions

This section presents the problem statement, research purpose and research questions used in the study.

1.2.1 Problem statement

Sand mining is considered one of the severe environmental problems that South Africa faces (Hamann, 2012). This is comprehensible because according to Bagchi (2010), sand mining projects or activities are one of the factors that have an impact on the environment towards land degradation. Environmental issues are ignored especially when people are benefiting from natural resources (Hamann, 2012; Saviour, 2012; Madyise, 2013; Chevallier, 2014; Pieterse, 2017). According to Madyise (2013), sand mining has since become a lucrative or profitable business for most areas in developed and developing countries. This is evident in that the number of miners and suppliers have since increased steadily in recent years. South Africa has a wide range of regulations and legislation about the mining of sand (Bromley, 2007). These include the National Environmental Management Act 107 of 1998, Environmental Management Plan and the Environmental Impact Assessment (EIA).

Gwimbi and Dirwai (2003) state that during sand mining activities, the impact of vegetation clearing and the formation of access routes to sites for large vehicles has probably been the most profound impact on land degradation. According to Hamann (2012), sand mining successively leads to hastened land degradation. Land degradation is further worsened by continuous heavy rains. Poor mining practices and

the mechanical exposure of the sand are the most vital causes of land degradation (Hamann, 2012). The importance of plants in the rehabilitation process and the prevention of land degradation cannot be overemphasized (Dlamini, Chivenge, Manson, and Chaplot, 2014) whilst appreciating infrastructure growth and development in the area.

According to Kori and Mathada (2012), the impact of sand mining on land degradation is the result of many of these unlawful operators exploiting the resource and abandoning sites without the implementation of any form of rehabilitation once the resource has been depleted. According to Hamann (2012), the irreparable degradation to the environment often results from these activities, which becomes a legacy that future generations will need to address. Currently, there is a new area in Mentz that is also developing at a faster rate since the community members are erecting houses.

It is important to note that the demand for sand is increasing hence the need to rehabilitate the environment is critical in this regard. According to Kori and Mathada (2012), the sand miners must rehabilitate the areas where they extract sand. Many of the sand miners aim to benefit from the mining operations and often extract sand from the various sites leaving open holes without any rehabilitation process of the area. Sand mining is also one of the main causes of deforestation because in order to mine, trees and vegetation have to be cleared and some burnt (Bagchi, 2010). The more there is demand for sand, it leads to land degradation since the sand miners have to keep up with the demand for sand by the residents as well as other stakeholders (Golmohammadi, 2012). At Mentz Village, there is an increase in demand for sand for construction due to the development that is taking place in the area.

1.3 Research Aim

The aim of the study was to investigate the impact of sand mining on land degradation and the significance of rehabilitation in Mentz Village.

1.3.1 Research Objectives

To this extent, the specific research objectives were formulated as follows:

- To examine the nature of sand mining;
- To assess the nature of land degradation;

- To explore how sand mining causes land degradation; and
- To establish the significance of rehabilitation in sand mining.

1.3.2 Research Questions

The general research question of the study was: How does sand mining have an impact on land degradation and rehabilitation? From the general research question, specific questions were formulated as follows:

- What is the nature of sand mining?
- What is the nature of land degradation?
- What is the impact of sand mining on land degradation?
- What is the significance of rehabilitation in sand mining?

1.4 Definition of terms

This section outlines the different concepts that have been adopted in the study. These concepts include mining, sand mining, land degradation and rehabilitation. These are the concepts that are used throughout the study in order to meet the objectives and to help the researcher to rejoinder the research questions.

1.4.1 Mining

This is defined as the practice that is used to extract sand from the ground. Mining is the extraction (removal) of minerals and metals from the earth (Madyise, 2013). For example, aluminium, iron ore, silver, sand and diamonds are just some of the resources that can be mined. According to Saviour (2012), “mine” can be defined as any operation or activity for the purposes of winning any minerals in or under the earth, water or any residue deposit whether by underground and open working such as the extraction of sand.

1.4.2 Sand Mining

This is a process that is used to extract sand or soil from the environment. Sand can be mined from beaches, inland dunes and dredged from the ocean beds and river beds (Saviour, 2012). Sand is an important resource because it is used to make bricks for any infrastructural purposes and other developmental projects. Sand mining is an

activity that can result in the disturbance of ecosystems, loss of biological diversity, pollution and degradation of the environment (Bromley, 2007). For the purpose of the study, sand mining refers to the process of extracting sand from the environment for developmental purposes.

1.4.3 Land Degradation

This is a temporary or permanent decline in the productive capacity of the land. It is the aggregate reduction of the productive potential of the land which includes its major uses such as arable, irrigated, farming systems and its value as economic resources (Anim & Chauke, 2014). This is a concept in which the value of the biophysical environment is affected by one or more combinations of human-induced processes acting upon the land. Land degradation happens all over the world but is a peculiar problem in parts of Africa and South Africa (Kori & Mathada, 2012). Land degradation is usually caused by human-induced processes or inappropriate or immoderate exploitation and can have temporary or permanent effects on the land (Anim & Chauke, 2014).

1.4.4 Rehabilitation

This is the progression of returning the land or property in a given area to its prior state (Hamann, 2012). For example, after some natural disasters have occurred, many projects and developments, which result in the land becoming degraded from sand mining, farming and forestry; land must be rehabilitated. Thus, rehabilitation is the process that is used to rectify issues that have been caused by the process of sand mining, coal mining and natural disasters (Hamann, 2012). The study adopts the definition of rehabilitation because it links to the two variables of the study, which are sand mining and land degradation. In this study, the term “rehabilitation” was used regarding sand mining in rural areas of South Africa, a case of Mentz Village.

1.5 Literature review

Literature has attested to the impact that sand mining has on land degradation and the lack of rehabilitation process (Hart, 1998; Madyise, 2013). For example, sand is a heavy resource that consists of very small pieces of rocks and minerals, because of weathering that forms beaches and desserts. Sand mining is a worldwide activity in

both developed and developing countries (Bromley, 2007). The practice of sand mining is becoming an environmental issue as the demand for sand as an important mineral resource is increasing in the construction industry.

1.5.1 The nature of sand mining

Sand is extracted from the environment due to sand mining activities and the operation is relatively unsophisticated and fundamental. The sand miners require instruments such as dozers for the clearing of vegetation and to build access roads as well. The barriers to entry are very low and sand mining operations can be set up at a relatively low cost. Sand mining is the extraction of sand from the environment. According to Bromley (2007), there are various kinds of sand mining which include amongst others the dry-pit mining, wet-pit mining and bar skimming, which are the pits on the adjacent floodplain. Sand is extracted from the environment by sand mining and the operation is relatively unsophisticated and rudimentary.

There are various consequences of sand mining. These include the depletion of the groundwater, lesser availability of water for industrial, agricultural and drinking purposes, destruction of agricultural land, loss of employment especially to farmworkers, the threat to livelihoods, the damage of roads and bridges and more relevant to the study, land degradation (Madyise, 2013). Infrastructural development, in particular, residential houses are expanding at an alarming rate (Mark, 2002). This development has also increased sand mining as it is used in the construction of houses because brick and mortar are still the main resources used for building. Sand mining has since become a lucrative or rather profitable business in these areas. This is evident by the increase in the number of miners and suppliers. According to the Constitution of the Republic of South Africa (1996), every citizen has a right to a clean and safe environment. The environmental regulation of mining in general and sand mining in particular is a rather complex affair and has been the source of conflict between various regulatory authorities.

1.5.2 The nature of land degradation

This is a composite term as it has no single identifiable feature that describes how one or more of the land resources such as soil, water, vegetation, rocks have changed for the worse. A landslide is often viewed as an example of land degradation in action

because it changes the features of the land, causes destruction of houses and disrupts activities. There are various causes of land degradation such as the overgrazing of rangeland, over-cultivation of cropland, waterlogging and salinization of irrigated land, deforestation, pollution and industrial causes.

There are legislative frameworks to regulate sand mining in the country. These frameworks are used as a set of rules or guidelines that can be put in place to solve certain problems that have occurred or can occur such as environmental problems. It is significant to adhere to the legislative framework to be able to mitigate the environmental issues. Numerous environmental acts are being implemented to ensure that sustainable development is always achieved to avoid compromising the needs of future generations. The aim of the environmentalists is to ensure that these limited resources are utilised in a proper manner to avoid the negative environmental impact (Madyise, 2013). These various legislative frameworks are used as tools to govern sand mining activities to prevent impact such as land degradation.

It is an indisputable fact that such economic development activities if not pursued responsibly can plunge many countries into environmental disasters. According to Paulse (2016), on 08 March 2016, the South African Department of Mineral Resources announced its intention to begin with the exploration of shale gas in the Karoo region. According to Government, fracking for shale gas in the region would be an economic boost for the country in terms of providing energy security for the country, economic growth and employment. However, the announcement was met with hostility from the anti-fracking campaigners known as Treasure Karoo Action Group (TKAG) who threatened to take the government to court if it continued with the fracking plans. According to Paulse (2016), TKAG believe that fracking uses huge amounts of water, which must be transported to the fracking site at a significant environmental cost. Furthermore, it emphasized that potentially hazardous chemicals used may escape and contaminate groundwater around the fracking site. This is, but one of the examples of the great divide between those who are for exploitation of natural resources for economic gains and those who are against this to protect the environment (Gleitsmann, Kroma & Steenhuis, 2007).

1.5.3 National Environmental Management Act (Act NO.107 of 1998)

Sand mining is an activity that can result in the disturbance of ecosystems, loss of biological diversity, pollution and degradation of the environment. The main aim of this Act is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. Everyone has the right to have the environment protected for the benefit of the present and future generations through reasonable legislative frameworks and other measures that prevent pollution and ecological degradation. This is legislation that promotes conservation and secure sustainable development and the use of natural resources while promoting justifiable economic and social development (Madyise, 2013).

According to Kori and Mathada (2012), despite legislative frameworks, policies and regulatory mechanisms put in place by Government to regulate sand mining activities; adherence to these mechanisms is still a challenge. Informal sand mining activities continue unabated. The researcher believes that training and educational programmes specifically meant to educate and train informal sand miners on the impact of their activities on the environment can generate a balance between economic benefits arising from sand mining, development and environmental protection. Thus, rehabilitation is also one of the strategies that can be used to ensure that these environmental effects are mitigated.

It is also substantial to note that having legislation in place alone cannot regulate sand mining activities. Miners may not even know the existence of such legislation and what the legislation means to them. Miners only harvest the sand, which often results in environmental and health risks for the communities (Madyise, 2013). In the aftermath of mining activities, communities use the remaining pits as dumping sites and they pollute the land. Furthermore, the pits are flooded during rainy seasons and become a conducive breeding ground for mosquitoes and other water-borne diseases. This also exacerbates the drowning of children who swim inside these deep holes that usually have water. Moreover, the researcher proposes that the stakeholder briefings can also be one of the alternatives to ensure that the sand miners are encouraged of the rehabilitation process after the practice of mining sand.

1.5.4 The impact of sand mining on land degradation

Stebbins (2006) states that as mining occurs, there is a loss of sand and this often leads to land degradation because there is depletion of the environment. Gravel pits are often used as dumping sites with tipper trucks carrying waste to dump as they come to collect sand and gravel. Pollutants from waste filter contaminate drinking water and affect people's health. Saviour (2012), observe the same impact of changing abandoned gravel pits into dumping sites as a serious effect of uncontrolled gravel mining in Kenya. In addition, air and water pollution are also one of the negative impacts of sand mining on the environment. Apart from depletion, sand mining can also cause significant damage to the environment, particularly to riparian habitats. Such damage can include land degradation, destruction of vegetation, altering the flow of a river, destruction of riverbanks, and destruction of wetlands (Saviour, 2012).

There are international treaties signed by different continents like the United Nations Convention on Climate Change (UNFCCC), continental and country-specific legislative frameworks and regulations to control the exploitation of natural resources for economic development. This is done neither to take an extremist one-sided view when it comes to pursuing economic development at the expense of the environment nor environmental matters at the expense of economic development. Land degradation is caused by many factors and one of them is land use mismanagement (O'Mara, 2012). Overuse of land occurs because of land mismanagement. Land use mismanagement is caused by a lack of knowledge and results in the depletion of soil organic matter. Land degradation is a huge problem that is persisting in many parts of the world (O'Mara, 2012).

1.5.5 The significance of rehabilitation in sand mining

According to Hamann (2012), sand mining is a consumptive use of the resource without considering the rehabilitation process of the environment in that the benefits of mining are based on the removal and the profit-making of the sand resource. Sand mining is the process of the removal of sand where this practice is becoming an environmental issue because mine holes are left behind without any form of rehabilitation (Dlamini, Chivenge, Manson and Chaplot, 2014). It is, therefore, important to rehabilitate the places where these sand miner's access sand. According

to Saviour (2012), permits for mining continue to be granted despite the environmental impact caused by sand mining. The rehabilitation process reduces the environmental and health threats because mine holes are left open, which encourages the unlawful dumping sites, worsens the drowning of children since they use it as a swimming area and it becomes a breeding place for insects such as mosquitoes for the community. When the environment is rehabilitated, this would lead to the sustainability of the environment and the environmental impact would be minimised. It is important to note that mine dumps, which are often called mine waste created by mining activities, are some of the environmental impacts of mining.

1.6 Limitations of the study

The study had few limitations, for instance, it was conducted at one small community, which was Mentz Village, hence, its findings may not be generalised to refer to South Africa as a whole.

1.7 Structure of the dissertation

Chapter 1: This chapter gives the introduction as it introduces the reader to the content of the proposal. Secondly, the chapter presents the problem statement as it traces the genesis of the problem statement, research aim, research questions, and research objectives, the definition of terms, literature review (four themes of the study), and limitations of the study, the structure of the dissertation and the summary of the study.

Chapter 2: This chapter discusses sand mining, land degradation and rehabilitation in international countries and how sand mining activities trigger tensions between the government and the community members in these countries worldwide. Furthermore, it discusses how in as much as sand mining and its activities serves as a source of livelihoods for the entire communities whilst on the other hand, triggers conflicts and the violation of human rights.

Chapter 3: The chapter provides a literature review of sand mining in South Africa and the international perspective of sand mining. This was done by giving the readers an understanding of the conceptualisation of sand mining and land degradation. Further, the researcher explores the effects of sand mining in South Africa in particular rural

areas. The researcher also tackles the rehabilitation of the land after sand mining has taken place.

Chapter 4: This chapter discusses the research methodology adopted to investigate the impact of sand mining on land degradation and the significance of rehabilitation in Mentz Village. This includes aspects such as research design, sampling, data collection, data analysis and ethical considerations. The study also explains the scope of the study area and the background of the study in the research.

Chapter 5: The contents of this chapter discusses data analysis and interpretation. The study explores the objectives set when the research was embarked on. Firstly, this chapter examines the nature of sand mining in Mentz Village. It assesses the nature of land degradation. Furthermore, it explores how sand mining causes land degradation and examines the significance of rehabilitation in sand mining.

Chapter 6: Recommendations and Conclusion. This chapter provides a summary of the study, and what conclusions have been reached, as well as make some recommendations to various stakeholders.

1.8 Summary and Conclusion

This chapter presented readers with an overall idea of the research carried out. It began by explaining the rationale and background of the study; the motivation or rationale for this study was emphasized. The chapter continued with the problem statement and research aim. Lastly, the main concepts utilised in the study were presented and the researcher revealed the synopsis of literature reviewed and the chapter outline. In chapter two, the discussion is on the international perspectives where the focus is on sand mining, land degradation and rehabilitation in various countries and how sand mining activities are regulated in the various countries.

CHAPTER TWO

SAND MINING, LAND DEGRADATION AND REHABILITATION: A GLOBAL PERSPECTIVE

2.1 Introduction

Sand mining is perceived as the most important activity for infrastructural purposes and other developmental purposes. This chapter discusses the various activities and methods used in various countries internationally and how sand mining leads to land degradation and what the significance of rehabilitation is so that sustainable development is achievable and sand mining activities are well regulated. Sand mining and its associated activities serve as a source of livelihoods for most communities whilst on the other hand, it can trigger conflicts and the violation of human rights.

2.2 The nature of sand mining world-wide

Sand mining and gravel extraction are a worldwide activity in both developed and developing countries (Draggan, 2008). Sand mining can also be defined as the extraction of surface sand from beaches and inland dunes, or the dredging of sand from riverbeds (De Leeuw, Schmid & Mennen, 2010). The sand that is being mined is typically sold to the construction industry, for the production of materials such as tiles, cement bricks and other sand aggregates (Hazou, 2017). Industrial sand and gravel are produced and processed in the construction and industrial sectors all over the world.

The leading nations in mining and processing sand and gravel are the United States of America (USA), Austria, Belgium, Brazil, India, Spain, Nigeria, Kenya and South Africa (Bravard, Goichot & Gaillot, 2013). This is because sand is a cheap and readily accessible resource such that many enterprises are involved in its mining both legally and illegally without considering the damage they are causing to the environment (Mark, 2002).

2.2.1 Sand mining in the United States of America

Sand is an indispensable natural resource for any society and any country. Despite society's increasing dependence on sand, there are major challenges that this industry

needs to deal with like the limited sand resources, illegal mining, and environmental impact of sand mining. According to Mark (2002), the USA is the largest producer and consumer of sand and gravel in the world as well as the leading exporter of silica sand to every region of the world. This is because it has extensive high-quality deposits of the resource combined with technology to process it into any product. Construction sand and gravel are produced in all 50 states. The highest producers are California, Texas, Michigan, Minnesota, Ohio, Arizona, Utah, Colorado and Washington (Baker, Gaill, Karageorgis, Lamarche, Narayanaswamy, Clodette, Santos, Sharma & Tuhumwire, 2016). They all produce approximately 52% (per cent) of the total amount of construction sand (Baker, et al., 2016). More than a billion tonnes of sand and gravel are produced and used annually. Due to high demand in these States, some sand and gravel are still imported from Canada, Mexico, Bahamas, and Australia (Baker, et al., 2016).

Stebbins (2006) highlights that in the State of Maine, sand and gravel deposits cover up to five per cent of the land. The resources are mainly used in construction and pumping drinking water which had increased demand so there are many sand and gravel pits. Approximately 260 acres of land are used for mining by both companies with and without licences. Construction grade sand and gravel have high volume; hence the resources cannot be transported over long distance (Sverdrup, Koca & Schlyter, 2017). Large trucks are used as transport for up to 48 kilometres, therefore, most pits are near the consumers as these bulky commodities normally cannot economically stand costs of long-distance transportation.

Most mining is done near the consumer in the USA (Sverdrup, et al., 2017). The once abundant supply of gravel and sand is rapidly diminishing in areas surrounding most cities in the USA (Stebbins, 2006). Sand mining is not much different from bulldozing mountain-tops to get to the coal beneath them in the USA (Evans, et al., 2002). It poses many of the same risks to nearby aquifers, streams and rivers. Like other large mining operations, it can put pressure on community infrastructures such as roads and other infrastructural developments.

Mark (2002), Schlachers, Lucrezi, Connolly, Petreson. Gilby, Maslo & Weston (2016) postulate that there are four basic operations used to extract sand from open-pit mines in the USA. The operations include site clearing to remove vegetation, then mining,

processing and finally reclamation of the mined area. Machinery commonly used for mining includes bulldozers, tractor scrapers, front-end loaders and stone crushers (Klanfar, Korman & Kujundžić, 2016). The mining is done almost 24 hours to keep up with the high demand internally and externally for sand and gravel (Mark, 2002). Madyise (2012) observes that in California and Michigan, many prime sources of sand are tropical deposits and old lake beds. These States have an abundance of sand and gravel which are well distributed. Many minerals are mined but sand and gravel are extracted most in the USA. Madyise (2012) further notes that river sand, pit sand and gravel are mined around large expanding urban areas.

There have been different negative effects noted in the USA due to in-stream mining occurring in rivers and streams. Kondolf (2007) defines in-stream sand mining as the mechanical removal of gravel and sand directly from an active channel. Forms of in-stream mining such as pit excavation causes degradation of rivers. The process occurs as head cutting or hungry water. When head cutting extraction is done on an active channel, it lowers the stream bed to create a nick point which steepens the channel slope and increases flow energy (Ashraf, Maah, Yusoff, Wajid, & Mahmood, 2011). Furthermore, fill material if the activities will cause only minimal adverse environmental effects when performed separately, and will only have a minimal cumulative adverse effect on the environment. Sand mining operations in the USA are regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act (the U.S. Code of Federal Regulations, Title 33, Chapter 26, Subchapter IV, Section 1344: Permits for dredged or fill material) (Genovese, 2000).

According to Baker et al. (2016), the USA government may also issue permits for any discharge or fill material into the navigable waters incidental to any activity. Reduce its purpose bringing an area of the navigable waters into use, to which it was not previously subject where the flow or circulation of navigable waters may be impaired or the reach of such waters. However, the code is actively being used to regulate sand mining activities in arroyos and washes of the western USA. Thus, the government issues permits to sand mining operators to comply with the requirements of the code, specifically, the avoidance of adverse effects on municipal water supplies, fisheries, wildlife or recreation.

2.2.2 Sand mining in India

Stebbins (2006) review soil mining in Indian communities and explains that as urban areas grow, less wood is used with more concrete structures being required leading to demand for low-cost sand. Sand and gravel are the most accessible, cheap and basic raw materials for the construction industry in India. As supported by Musah, (2013); Singh, Rishi and Sidhu, (2016); Gitonga, (2017), there is a business of indiscriminate sand mining in public spaces like in India. Soil mining is an environmental issue in India and public awareness of illegal extraction in the States of Maharashtra and Goa is going on (Pereira, 2012). Bagchi (2010) supports Madyise (2012) on that the construction boom fuelled the demand for sand mining facilitating uncontrolled extraction which threatens the existence of river systems. Illegal mining of mineral resources is rampant in India such that the country's natural resources are destroyed as forests are cut down.

Pereira (2012) researched sand mining in India by studying three villages in Maharashtra and realised that as global demand for sand is exploding and rising rapidly, the sources of sand and gravel such as riverbeds, beaches, creeks are being mined faster than nature can replenish. He indicates that this creates a highly skewed supply and demand situation. Paulse (2016) notes that India has the third-largest construction business in the world after the USA and China, therefore, sand is required in large quantities. India did not have a regulatory and monitoring framework for the excavation of sand sustainably which increased the illegal mining rampantly (Padmalal & Maya, 2014). This led the Mumbai High Court to issue a ban on sand mining in 2010 to all licensed and unlicensed miners who were damaging the riverbeds and increasing the threat of floods (Madyise, 2012).

There is also an increase in the demand for sand because of construction and other purposes as communities grow at a fast rate. The construction at present requires more concrete and less wood like in the past, which can sprout low-cost sand. According to O'Mara (2012), sand mining is widespread, highly unregulated and uncontrolled in such a manner that it is being carried out at an alarming rate. Social pressures like population growth can also cause the environmental impact of these increase in mining. Although sand mining contributes to the construction of buildings and development, its negative effects include the permanent loss of sand in areas as

well as major habitat destruction. Sand mining is regulated by law in many places but is still done illegally and without any rehabilitation processes after the activity. Consequently, the majority of both active and inactive sand mines are located along interstate highways or major state and country roads.

2.2.3 Sand mining in Belgium

Sand mining and the environment present major environmental effects and consequences of sand exploitation based on the analysis of existing literature associated with this issue in various countries (Yen & Rohasliney, 2013; Bayram & Önsoy, 2015; Asabonga, Mpundu & Vincent, 2017). Underdeveloped and developing countries, where governments often lack the capacity to establish and enforce environmental regulations, are usually confronted with illegal sand mining operation, leading to a series of environmental issues and threats. Accordingly, special attention will be paid to the affected countries so that sustainable development will be reached without compromising the need for developmental achievement. In Belgium, the percentage of sea sand production in relation to total sea sand production has continued to rise since the 1970s (Phua, 2002). Sea sand is used in the construction sector as well as to protect the Belgian coast. In Belgium, sand and gravel are mined in the Belgian part of the North Sea (Musah, 2013; Singh, Rishi & Sidhu, 2016; Gitonga, 2017).

2.3 Sand mining in Africa

Sand mining and dredging are critical to infrastructure development around the globe. It is used in the manufacturing of abrasives, concrete and is mixed with salt to use on icy roads (Phua, 2002). Sand dredging can extract various minerals that contain useful elements like titanium. Sand mining can also be used in the replacement of eroded coastline. It is important to note that most people resort to the sand mining business to earn a living. Given the number of sand mining operations in existence, the fact that sand extraction rates exceed sediment yield and the significant impact that sand mining has on the environment, it is self-evident that sand mining needs to be strictly controlled. Most of the African states are still developing and benefit from the use of natural resources such as sand and gravel for economic development.

2.3.1 The Sustainable Livelihoods Framework Analysis

Scoones (1998) presents a version of the ‘assets-mediating processes-activities’ framework that is used in various ways by researchers concerned with poverty reduction, sustainability and livelihood strategies. This is a framework initially for the analysis of rural livelihoods. However, Scoones (1998) clarifies that it can be used in the analysis of the livelihood status of individuals, households, villages, communities or districts. It is applied in this study to help in understanding the situations that lead urban households to undertake informal natural resource-based livelihood activities, particularly artisanal and small-scale mining. Ellis (2006) points out that the starting point of the framework is on the assets owned, controlled, claimed or accessed by the household. These foundations enable households to engage in production, labour markets and participate in reciprocal exchanges with other households. Ellis (2006) categorizes the assets as human resource (especially skilled), physical, financial, social and natural resource assets.

Natural resource capital comprises land, water and biological resources that are utilized by people to generate means of survival, sometimes referred to as environmental resources (Musah, 2013; Singh, Rishi & Sidhu, 2016; Gitonga, 2017). Within this, there is a distinction between renewable resources, which replenish themselves over time such as fishery stocks and non-renewable (depletable) resources, which are mainly extractive such as oil and metals. Ellis (2006) explains that physical capital can be substituted for natural capital and thus ease the pressure and depletion exerted on the latter. Unfortunately, the poor, who do not have substantial physical assets rely on the natural resources for livelihood sustainability such as individuals that are involved in sand mining. This natural resource extraction is the most convenient way of earning a living for the poor as it does not require high investments to access. The different environments, categorized into social relations, policies and institutions, mediate them. Social relations involve the networks through which information passes along. The institutions may include issues of legality of the activity and how the prices are set.

2.3.2 Sand Mining in Uganda

Looking at Uganda for example, the sand mining activity was at first a way to elevate poverty. The Lake Victoria Basin is endowed with alluvial depositions that contain sand, which is highly sought by the construction industry. The deposits of sand in the basin are deeper in the west, especially around Lwera and Bukatata. It is therefore not surprising that out of all permitted sand mining projects, over 80% of them are based in the west of the Lake Victoria basin, wholly in Lwera (Kairu, 2001; Myers et.al, 2019). In Lwera, commercial sand mines are recent, and their emergence over the years is wholly attributed to a growing demand for clean sand. The situation now contrasts with the olden days when sand was mined using local tools, such as hoes and spades. During that time, large scale mining in Uganda was limited to Bukakata, in the 1960s, where sand was mined to support glass making by the East African Glass Works Limited and it is well known that with mining comes the impact, and Lwera has not been spared (Byram & Onsoy, 2015).

A traditional fishing village, Kamaliba, which is surrounded by three mining companies, has been ravaged by the activities of these miners. The village has lost shelter, toilets, access roads, recreation land and land for cultivation, as some of the developers have expanded their mines beyond the permitted boundaries. Communities have not benefited from the trade, save for the casual jobs, which fetch them just enough money to survive. There is also a danger of silicosis, a disease associated with the inhalation of silica dust. The activity has a hidden impact on the roads sector, which is rarely discussed. It is important to note that heavy vehicles carrying sand damage roads and hence increase the cost of maintenance of these roads (Mbiyana, 2018).

To understand the viability of the sub-sector and guide on its taxation, it is recommended that this impact be accounted for. In addition, the narrow highways used by the heavy trucks carrying sand become death traps because the trucks are slow-moving and the roads are bad in places (Mbiyana, 2018). The open pits resulting from sand mining are a habitat for disease-carrying vectors, such as mosquitoes. They are also habitats for invasive aquatic plants like the water hyacinth and Kariba weed. The former plagued Lake Victoria almost two decades ago was contained, but its re-emergence in areas close to the lake is worrying (Odada, 2006).

2.3.3 Kenya sand mining

Sand mining is an activity that has been carried out for centuries, mainly for construction purposes (Orr & Krumenacher, 2015). Often, the construction industry prefers sand from the riverbeds, flood plains and the shores of the lakes. Kenya is no stranger to these issues of uncontrollable sand mining activity looking at the Mwingi Sub-County, Kenya where the River Kivou is a tributary of river Enziu (Piyadasa, 2018). Over the last two decades, sand mining activities have been carried out in this river, with the intensity of the exercise increasing progressively with time. Kitui County has exacerbated the rate of sand mining (Anyona & Rop, 2015). Such high levels of sand mining are conceived to be driven by factors such as high demand for sand in the construction industry, high levels of unemployment, and the adverse climatic condition of the study area, which limits the inhabitant's economic options. The Kenya Institute for Public Policy Research and Analysis predicted that the economy would grow by about 5.5% in 2013 and 6.3% in 2014, compared with 4.6% in 2012 (Megersa, 2017).

Many of Kenya's poor youngsters are turning to sand mining as a quick way to earn money, despite the deadly risks and Karanja is among many young people facing exploitation in the industry. According to Mary Muthoni, an official with local government child welfare, about 3,000 young people, most of whom are underage, are involved in some of the worst forms of labour here, including sand mining (Hindman & Hindman, 2014). Sand mining in river Kivou is an activity that is associated with adverse environmental and social impact. Sand mining in River Kivou has contributed to the Enziu river's siltation and poses a threat to nearby public utilities and infrastructure such as roads and schools (Hilliard, 2010). Sand harvesting in Rift Valley is done along the riverbeds, which is of poor quality as compared to earth sand mining in parts of eastern Kenya. Further, it has led to lowering of the water table in the sand reserves along the river channel, a factor that leads to drying up of shallow water holes sunk thereof thus subjecting the locals to suffering. Additionally, the activity has led to the destruction of the riparian vegetation as well as destabilizing the banks of the channel.

According to Saviour (2012), the rate of soil mining in Kenya is so alarming that the government had to draft the National Environment Management Authority (NEMA), a

policy to apply to all mining activities. This policy was put in place to ensure proper and sustainable mining of soil. Stebbins (2006) spelt out the creation of employment in Kenya particularly to people living near the mining areas as a positive impact.

2.3.4 Sand mining in Malawi

Due to high unemployment levels experienced in urban cities of Malawi specifically Lilongwe; many poor and lowly skilled unemployed people have resorted to informal activities such as small-scales and mining (Rohregger, 2006). Sand mining in Malawi has been given impetus by the increase in construction activities and has become a considerable source of income for some households (Arwa, 2013). This income-generating activity has become common such that it is done even in sites such as roadsides. Although this is the case, sand mining extraction activities along river banks, within and around households and along the roads are perceived as a norm by certain quarters which is unlawful and punishable by law (Majawa, 2016).

Sand mining is mostly illegal in most of the countries where it is rampantly carried out like in Malawi. Most of these miners do not have legal rights to carry out the activities as they are done in areas that are reserved for either residential housing or commercial purposes. The activity affects the environment negatively, erodes and distorts river banks such that increases in water flow quantity causes erosion easily and results in washing houses and farmland away (Khan & Sugie, 2015). Although sand mining has devastating effects on the environment, several authors show that households engaged in this informal activity, derive a large portion of their income from sand mining, which could contribute to household poverty reduction (Fandamu & Fandamu., 2018).

The underlying point is that for most of those who have no access to physical or financial capital, reliance is placed on the environment for survival regardless of whether it is environmentally friendly or not (Ellis, 2006). The framework thus helps to inform policy on exactly who and where to target and how. Although the percentage of the Malawi population involved in mining and quarrying is relatively small (less than 1%), the population of these miners is unknown (Brebbia & Hassan, 2017). The fact that they are contributing to the development of the towns and cities is irrefutable because to some extent they support the construction industry. In addition, they are

said to support not only themselves but also their families and other dependents. They also support the local economy in that many miners do not process and sell to the final consumer themselves; instead, they sell to intermediaries who transport the products to markets, thus creating a value chain (Brebbia & Hassan, 2017). Thus, they can be considered as contributing positively to poverty reduction. The question, however, is whether these activities, particularly those informal, are sustainable as livelihood strategies considering the effects on the environment (Myers & Medley, 2019). According to Waseem, Mohammed, Sana & Aruna (2019) another information gap, specifically in Malawi is on the significance of the contribution of the activities to household poverty reduction.

2.3.5 Sand mining in Nigeria

Madyise (2012) discusses sand mining in Nigeria and highlights that the activity is rapidly becoming an ecological problem as demand for gravel and sand increases. The resources are used in the construction of strong structures, which improves the socio-economic lives of most Nigerians though with notable negative environmental impact. The locally studied effects of sand mining activities reveal that mining sand and gravel on agricultural land is one of the alternative livelihood activities of the rural people in Nigeria, which is now becoming an environmental issue (Madyise, 2012). Lawal (2011) examined sand and gravel mining activities both on land and in rivers as a business venture in Minna Emirate Council of Niger State. Stakeholders from the mining activities were listed as landowners of quarry sites who sold the sand and gravel to private and government contractors (Yen & Rohasliney, 2013; Bayram & Önsoy, 2015; Asabonga, Mpundu & Vincent, 2017). The activities also involve farmers whose cultivating and grazing lands are destroyed, wildlife community whose habitats are mined areas, aquatic community members as well as miners themselves (Nthambi & Orodho, 2015).

Aromolaran (2012) carried out a study to examine the effects of sand mining activities on rural people living on agricultural land in Ogun State, Nigeria. Many people supported the good uses of sand but the negative impact on their land was more than the benefits. Lawal (2011) highlights that sand mining is rapidly becoming an ecological problem as demand increases in many states of Nigeria's industry and construction sectors. The mining is done both legally and illegally leading to

environmental devaluation. According to Ako et al. (2014), Luku is located in North Central Nigeria and sand mining is currently taking place there because the place is a very attractive source for these materials. The area is easily accessible and the materials are easy and cheap to extract by the miners. Mining of these materials in the area is being carried out without any attention given to the negative environmental impact associated with the activities. Sand and gravel activities generate revenue and income to local governments and land owners in Africa's developing nations, which alleviates poverty. This was noted by Lawal (2011) in Niger State of Nigeria where financial benefits from mining work show that local government earn so much from these mining operations.

2.3.6 Sand mining in Zimbabwe

While sand mining has become a big business in Harare and surrounding places due to infrastructural development, which has seen the sprouting of new residential suburbs, the demand for pit and river sand, continue to grow. Pit and river sand is used for brick moulding and making mortar needed to make concrete. Sand poachers, mostly unlicensed small-scale operators are prevalent in 14 hot-spots areas that include peri-urban areas like Chitungwiza, Epworth, Mt Hampden, Waterfalls Retreat and Hopley. The illegal activities by sand poachers bear a huge cost towards land rehabilitation. As an Environmental Management Agency (EMA), in the wisdom of the legislation, there is a Statutory Instrument, which made it mandatory for those engaging in soil extraction for commercial purposes to be registered.

Zimbabwean law is clear that people are not allowed to extract sand without a license and an operating license must be applied for and obtained from EMA to mine sand at designated areas. Part of the Statutory Instrument 7 of 2007 for Environmental Impact Assessment (EIA) and Ecosystem protection, states that no person shall excavate, remove, possess or license the removal of clay or sand deposit for commercial purposes without a license by the same agency.

The City of Harare spokesperson, Michael Chideme as stated in the Herald (2017), confirms that there are designated sites in Harare for sand mining, although he could not immediately disclose the areas. As supported by Nthambi and Orodho (2015), adverse effects to the environment have been noted in areas where sand poaching is

prevalent, creating unsightly deep pools exposing people to the risk of drowning and death during the rainy season. It is important to educate communities to practice land rehabilitation to guard against land degradation, protecting the environment. As the high unemployment rate remains a major challenge in Zimbabwe, the Chitehwe area of rural Seke in Chitungwiza has become a hive or rather a store of activity with sand poachers having pounced on the area, digging holes in search of the pit and river sand and, in the process, causing damage to the flora and fauna. As stated in the Herald (2017), one of the youths engaging in the detrimental activity, defended it saying sand poaching was a better way of earning a living than criminal acts like robbery.

When News Day (2011) visited the Chitehwe area in rural Seke, Madovi said the EMA personnel and the police have always fought running battles with the sand poachers. As one of the youth in Zimbabwe stated that they are unemployed and sand poaching provides them with a source of livelihood. “Otherwise if we do not do this, we might end up resorting to robbing people of their belongings.” Chenjerai Marasa, another youth who owns a lorry and sells the sand for a profit, concurred with Mudovi and said it was difficult to get jobs. “We don’t allow people from elsewhere to come and dig for sand in our area. We discussed this with our parents in the community and the chiefs, and they said since we were unemployed we should make use of our natural resources. In some ways our activities are benefiting the community,” said Madovi. However, the Zimbabwe Environmental Law Association projects co-ordinator, who is also an expert in environmental law, Gilbert Makore, said illegal sand poaching was dangerous to the community, the environment and the people who engage in those activities.

It is stated in the EMA that such illegal activities should be stopped because besides causing damage to the environment in terms of creating pits, the sand poachers do not use the right equipment to extract that sand from the ground. Gilbert Makore said the activities did not benefit the communities where that sand was extracted and it was mainly construction companies that were promoting those illegal activities. In most cases, it is construction companies that dig for that sand and they do not have any consideration for those communities. That is why there is a need for environmental management plans to be handed to EMA by these big companies.

According to Dlamini (2014), the impact of sand mining activities on rivers include short-term turbidity at the excavation site due to sediment reduction, in addition to other environmental impacts such as increased erosion and collapse of riverbanks that increase suspended solids at the excavation sites and downstream rivers. Sand mining can be defined as activities associated with extracting sand from the ground. Although sand can be artificially manufactured by crushing coarser aggregates such as stone and gravel mined from a quarry, this analysis focuses on the mining of natural sand from the environment, particularly sand that is found along shallow waters of rivers.

It is estimated that a sand miner would require basic equipment such as a dozer to clear vegetation and build access roads, an excavator or front-end loader to scoop up sand from the deposit, and trucks to carry the sand away. Such an activity can be set up at a relatively low cost, and it is envisaged that barriers to entry are low (Pavlos, Penelope & Ricos, 2018). In Zimbabwe, rapidly expanding suburbs have led to high demand for construction materials, including the sand needed to make concrete, but by poaching and selling sand, sand miners are degrading the same suburbs they are helping to build. Harvesting sand causes erosion and environmental degradation, but in Zimbabwe's faltering economy, sand poachers say few employment options exist.

Unregulated mining of large volumes of sand along beaches leads to their erosion. Sea beaches are usually formed by the balanced action of depositional and erosional forces. Although this balance is naturally maintained, human interference causes excessive erosion and thus the retreat of beaches. By removing too much sediment from rivers, sand mining also leads to the erosion and shrinking of riverbanks. Deltas can recede due to sand mining. All of these destructive effects of sand mining ultimately lead to the loss of fertile land and property. It also destabilizes the ground and causes the failure of bridges, dikes, and roads. Beaches are located at the intersection between the ocean and land. As such, beaches are home to a variety of species like crabs, snails, and turtles. When sand is mined in beaches, it disturbs the wildlife living in the beach ecosystem. After laying their eggs, the turtles cover them with sand to protect the nests from predators. When the hatchlings emerge, they move across the beach and enter the sea. However, when sand mining occurs in turtle nesting habitats, it leads to the loss of nesting sites. Therefore, sand mining can be a

factor responsible for the disappearance of a species. The negative effects of sand mining on local wildlife are visible in the case of gharials, the fish-eating crocodiles in Zimbabwe. Sandbanks are essential for the critically endangered gharials to build nests and bask in the sun. Unfortunately, despite efforts made to conserve the species, illegal sand mining in the range of the gharials has destroyed the much-needed sandbanks in their habitat. The species is now nearly extinct.

2.4 The nature of land degradation

The different negative impact had been realised in the USA due to mining occurring in rivers and streams. Kondolf (2007) defines mining as the removal of gravel and sand directly from an active channel. Forms of in-stream mining such as pit excavation and degradation of rivers. The process occurs as head cutting or hungry water. When the head cutting extraction is done on an active channel, it lowers the streambed to create a nick point which steepens the channel slope and increases flow energy. Bagchi (2010) discusses environmental land and surface degradation as a serious impact of in-stream mining on Indian rivers. There is damage to river banks and general ecosystems due to access ramps to riverbed (Kori & Mathada, 2012).

Soil erosion occurs as there is a disturbance of groundwater and changes in river courses. Continuous removal of sand from river bed increases the velocity of flowing water which erodes beds and banks. Kondolf (2007) notes that as the velocity increases, the river bed can propagate both upstream and downstream for many kilometres. Stebbins (2006) added that in-stream sand mining destroys aquatic and riparian habitat through large changes in channel morphology, lowered water table, instability and sedimentation at mining sites due to stockpiling and dumping of excess mining materials.

Several negative impacts were noted on habitats. Stebbins (2006) observe that valuable timber resources and wildlife habitats are destroyed, as all species require specific conditions to ensure long-term survival. Native species in streams and rivers are uniquely adapted to conditions that existed before human began large-scale alterations, which favoured some species over others (McMillan, Liebens & Bagui, 2018). Mining operations involve deforestation, habitat destruction and biodiversity erosion (Saviour, 2012). Madyise (2013) notes that sand and gravel mining generate

extra heavy vehicles and traffic, impairing negatively on the environment. Heavy vehicles cause access roads in the riparian zone and compact the ground. Saviour (2012) supports Lawal (2011) on the formation of access roads on river beds as heavy machinery and tipper trucks move to collection points. There is general destruction to roads and bridges. Villagers near mining sites feel this effect more as the continuous movement of heavy vehicles causes problems to cattle posts, agricultural land, borehole and well users. Furthermore, besides compacting land, heavy vehicles are a source of pollution to the villages near mining sites.

Madyise (2012) claims that noise and air pollution occur as dust accumulates from gravel roads, which is a reality in villages near mining areas. There is general degrading of the ecosystem. Air pollution caused by dust particles can be a health hazard causing respiratory disorders such as asthma and irritation of the lungs (Saviour, 2012; Guan, Zheng, Chung & Zhong, 2016; Mannucci & Franchini, 2017). The ground vibrations produced can cause ground tremors. Pereira (2012) claims that sand is dredged illegally 24 hours a day, all year round even during monsoons using mechanical dredgers. These produce a lot of noise which hampers sleep and normal school operation hours. Vibration noise generated from overburden excavation and transport is severe at night and is an annoyance to people.

Sand is the most important resource in economic development worldwide but the continuous removal has diverse effects on the environment (Gavriletea, 2017). The negative environmental impact seems to outweigh the positive effects of mining in the whole world. Social pressures such as population growth can also cause environmental impact. Some of the other impacts of sand mining are the abandoned pits that serve as a breeding ground for the spread of diseases, loss of economically important trees and cause pollution of the underground water. Sand mining results in the loss of sand in the area, habitat destruction, noise and pollution (both air and water pollution). According to Ako, Essien, Indris, Oke, Onoduku, Umar and Ahmed (2014), the law in many countries regulates sand mining. Ako et.al. (2014:43), states, “Mining of sand on farms and fallow agricultural land is becoming common and this is having a noticeable impact on the soil structure and vegetation in the rural areas”.

There are various consequences of sand mining which include land degradation, the depletion of the groundwater, lesser availability of water for industrial, agricultural and

drinking purposes, destruction of agricultural land, loss of employment with regard to farm workers, the threat to livelihoods, the damage of roads and bridges and more relevant to the study the land degradation (Madyise, 2013). In terms of infrastructural development, residential houses are expanding at an alarming rate (Mark, 2002). This expansion has also increased sand mining, as it is used in the construction of the houses because brick and mortar are still the main resources used for building. Sand mining has since become a lucrative or rather profitable business in these areas (Mohammed, 2017). This is evidenced by the increase in the number of miners and suppliers. The environmental regulation of mining in general and sand mining is a rather complex affair and has been the source of conflict between various regulatory authorities.

Sand and gravel had been a useful natural resource for thousands of years worldwide and are fundamental to human existence (Azarang, Jafari, Karami & Bejestan, 2018). The demand for sand and gravel has increased. Mining operators in conjunction with resource agencies need to work hard and make sure the extraction is done responsibly. Development is a process of adding improvements to a piece of land such as grading, drainage and access roads. Schaetzl (1990) defines aggregate as a substance made from several materials such as river sand and gravel. Pit sand is mixed with cement to form concrete, mortar and plaster for the construction of strong structures (Madyise, 2013). Aggregate is used to make road bases and coverings, concrete products and shoreline protection. Mining of sand and gravel had been done for road and cement aggregate for centuries worldwide.

Most of the African states are still developing and benefit from the use of natural resources such as sand and gravel for economic development. The demand for the resources increased in most Nigerian States by the 1990s, when individuals were getting schemes for home ownership such as an increase in salaries and house loans, which were easily accessible. Every citizen could afford to build a better house. This led to a better socio-economic life for rural people. In Kenya, soil mining had led to the development of better infrastructure (Ako et.al. 2014). This was supported by Ako et.al. (2014) as a positive impact of sand mining in Botswana where more land had been used to develop infrastructure in a form of shopping malls and residential areas. Zimbabwe is not an exception in benefiting from sand through infrastructural

development (Stebbins, 2006). For more than a decade, Africa has enjoyed a mineral boom. Although Africa's natural resource boom has spurred growth, questions remain whether it has also improved living standards. The conversion of growth into poverty reduction is considered to be much lower in Africa than in the rest of the developing world (Christiaensen, Chuhan-Pole, & Sanoh, 2014), and the low growth elasticity of poverty is attributed to natural-resource-led growth, a factor that underlies the disappointment that is often felt following a natural-resource-led boom. The disappointment is all too familiar at the national level across different countries, but increasingly there is a growing interest in understanding whether local sand mining communities benefit from the natural resource boom and, if they do not, what are the possible reasons that might explain it.

Looking at the practice of sand mining across the continent, it is safe to state that only a handful of countries have put strong regulations to govern the sand mining activities taking place in a particular region. Therefore, it is a great concern on the way the environment is disturbed by the excessive removal of soil for the construction industry especially in urban development in Africa (Mwangi, 2008, Gavriletea, 2017). It is noted that for thousands of years, sand and gravel had been used to construct strong houses, roads and dams in Africa since they are cheap and readily accessible resources. According to Hamann (2012), today's demand has increased as the socio-economic life of Africans has improved generally. Sand mining and gravel extraction are common in most African states but done both legally and illegally. According to Gwimbi and Dirwai (2003), sand mining had not been a common business in Zimbabwe. There had been the massive construction of new buildings, extensions and renovations in Harare and surrounding areas since 2009 when the US$ began to be used in the country. An EMA sand abstraction licence is obtained first before mining (Moyo, Chivivi, Mapuwei & Masuku, 2015). Steps followed in the mining process according to EMA are the removal of topsoil, extraction of sand and gravel to a depth of one metre then land reclamation takes place (Moyo et al., 2015). Land degradation is one of the most effects caused by sand mining activities in the whole world. This is because the economies are developing and the demand for sand is increasing.

2.5 The importance of rehabilitation after the extraction of sand around the world

Sand mining destroys the existing vegetation and the underlying soil profile. After mining has started, the original landscape is disturbed, ecosystems are removed and ecological functions are destroyed. As a result, several changes occur in the physical soil properties after the mining of sand. This leads to the detrimental impact on the environment. Rehabilitation is the process of establishment and care, as part of the process of reclamation and restoration (Lamb & Gilmour, 2003). The biggest challenge of rehabilitation is to establish a sustainable ecosystem that is self-productive and able to survive without the continued intervention of irrigation, fertilization or re-seeding. Sand mining activities have various impact on the environment (Syah & Hartuti, 2018).

The destruction of agricultural activities is one of the impacts caused by sand mining activities. After the mining of a landscape has ceased, processes of self-restoration are often slow and the final product of community plants may not be the most desirable. Rehabilitation should be planned before mining commences. Each operational stage and component of the mining should be part of a plan, which considers the full life cycle of a mine site. There are various methods used by international countries as a means to rehabilitate the environment after sand mining extractions and they are discussed as follows:

2.5.1 Rehabilitation techniques during mining

The following techniques are recommended during sand mining for the purposes of rehabilitation.

2.5.1.1 Use of environmentally friendly technology

Mining activities geared towards a successful rehabilitation involve the execution of the plan specified prior to mining (Oberholzer, 2016). Depending on a number of morphological criteria associated with the ore (depth, dissemination, segregation in a formation or datum level, dip, type of substance), a mining method designed for optimal recovery in terms of quality and cost should be put into action among the many mining methods available for surface mining. This includes the use of technology that

is more environmentally friendly. At each operational stage of the extraction, the types of chemicals involved and the choice of implements should be taken into account.

2.5.1.2 Top soil management

The top soil is viewed as the strategic rehabilitation resource that must be conserved during mining to protect its physical and chemical properties and biological processes (Cooke & Johnson, 2001). The top soils are usually higher in organic matter, microbial activity, and nutrients than the underlying subsoil or geologic material. Top soils contain significant seed bank that can be used to great advantage in re-vegetation.

2.6 Summary and Conclusion

Sand mining is still a challenge to most countries globally, more especially in developing countries. The literature review focuses on the international perspective in countries like the USA, India, Belgium and a couple of countries in Africa. The countries that have regulated the sand mining activities are on the right track although the issue of rehabilitation is still a challenge. A detailed summary of the literature review will be discussed in the following chapter three, which will include the international and South African perspectives.

CHAPTER THREE

SAND MINING, LAND DEGRADATION AND REHABILITATION: THE SOUTH AFRICAN PERSPECTIVE

3.1 Introduction

The literature review discloses the opposing views regarding sand mining, land degradation and the significance of rehabilitation in South African rural areas as indicated in the introductory chapter. This chapter discusses the themes that are used in the study, for instance, the nature of sand mining, the nature of land degradation, the effects of sand mining on land degradation, illegal sand mining and the significance of rehabilitation in sand mining. Lastly, the chapter provides the debates on sand mining, land degradation and the significance of rehabilitation in rural areas.

3.2 The nature of sand mining in South Africa

The study conceptualized sand mining, the definition of sand mining, sand mining in the world, sand mining in South Africa and sand mining in the rural communities. Natural sand from the river mouth and coastal land is one of South Africa's most valuable resource. However, there has recently been a drastic increase in uncontrolled and unauthorised sand mining activities in rivers and valleys throughout the country. Uncontrolled and often illegal sand mining activities are destroying some of South Africa’s most valuable natural resources at an unprecedented rate. For thousands of years, sand and gravel have been used in the construction of roads and buildings. Today, the demand for sand and gravel continues to increase (Gavriletea, 2017). Mining operators, in conjunction with cognizant resource agencies, must work in tandem to ensure that sand mining is conducted responsibly. The amount of sand mined is increasing exponentially, mainly because of rapid economic growth in the world and the resulting boom in construction.

3.2.1 Conceptualization of sand mining in the South African context

Sand is extracted from the environment due to sand mining activities and the operation is relatively unsophisticated and fundamental. The sand miners require the instruments such as dozers for the clearing of vegetation and to build access roads as well as trucks to cart the sand away (Green, 2012). The barriers to entry are very low

and sand mining operations can be set up a relatively low cost. Sand mining is the extraction of sand from the environment (Amponsah-Dacosta & Mathada, 2017). According to Bromley (2007), there are various kinds of sand mining, which include amongst others, dry-pit mining, wet-pit mining and bar skimming that is pits on the adjacent floodplain. Sand is extracted from the environment by sand mining and the operation is relatively unsophisticated and rudimentary (Gavriletea, 2017).

Unscientific mining has led to degradation accompanied by subsistence and consequential mine fires, severe ecological imbalance around mining areas (Saviour, 2012). Negative effects on the environment are unequivocal and are occurring around the world. The volume being extracted is having a major impact on rivers, deltas, coastal and this result in loss of land through river or coastal erosion, lowering of the water table and decreases for supply (Hazou, 2017). The practice is becoming an environmental issue as the demand for sand as an important mineral resource is increasing in the construction industry. Sand mining is the extraction of sand from the environment (Hazou, 2017).

Sand mining is known as ‘sand winning’ and the term ‘winning’ is referred to in the official definition of ‘mine’ (Stebbins, 2006). Sand mining is used throughout the whole study as well as the concept of land degradation and the significance of rehabilitation in the rural areas of South Africa. This is the practice that is used to extract sand from the environment (Saviour, 2012). Sand mining is an activity that can result in the disturbance of ecosystems, loss of biological diversity, pollution and degradation of the environment (Bromley, 2007).

Sand mining activities are taking place in the communities because of the demand from the community members due to the infrastructural development that takes place (Carvalho, 2017). However, these activities have an impact on the environment because the trees are removed so that the sand miners can have access to the sand resource (Saviour, 2012). This hinders the goal of achieving sustainable development because the land is degraded and there are rehabilitation processes that take place. For example, environmentally, when cutting trees, other trees must be planted for ensuring sustainable development. The environmental impact is increasing while there is an increase in the demand for sand in the rural areas for construction purposes (Madyise, 2012). Stebbins (2006) gave the background to the formation of sand

deposits, a legacy of the continental ice sheets that melted thousands of years ago. As the ice melted, fast-moving rivers were formed leaving deposits of abrasive sand (Killey, 2007). Sand and gravel deposits are porous and water can pass through this geological material, making it a source of high-quality water (Stebbins, 2006).

Sand mining is an activity that has a significant environmental impact and its implications related to land use planning. Hence, this is subject to the environmental and land use planning legislative framework (Morrison- Saunders & Retief, 2012). Sand mining is an activity that can result in the disturbance of ecosystems, loss of biological diversity, pollution and degradation of the environment (Sunlu, 2003). It is of paramount importance that pollution, degradation of the environment must be avoided, and where they cannot be avoided, they must at least be mitigated.

3.2.2 Sand mining in the South African context

Sand is an important resource for the developmental needs of the people (Hase & Davis, 1999). A key resource is utilized in developmental projects in both developed and developing countries. In this section, the discussion is based on both the positive and the negative impact of sand mining. Sand mining and its associated activities serves as a source of livelihoods for the entire communities whilst on the other hand, it can trigger conflicts and violation of human rights (Lawson & Bentil, 2014).

Although often small-scale and distant, these activities are exceeding the regenerative capacity of many rivers, low areas of land and the tidal mouth of the large rivers throughout the country. A new South African Institute of International Affairs (SAIIA) policy briefing explains that the cost of these unsustainable activities is far-reaching, with large economic, social and ecological consequences for South Africa and local resource users. The frameworks governing small-scale sand mining in South Africa lack the necessary resources to support better environmental compliance and the enforcement of these mechanisms will successfully prevent illegal activities. This is more especially when looking at the rural communities where the South African government often turns a blind eye.

Existing policy and management responses lack the urgency needed to avert the irreversible destruction of these riverine environments and conserve sand as a finite resource. Better enforcement is needed to discourage illegal sand mining and to end

the extraction of all river and estuarine sand mining (Chevallier, 2014). This should be done while concurrently seeking more sustainable sources of sand for the fast-growing construction industry. Wantzen and Mol (2013) carried out research on the authorisation and licensing of sand mining and realised that it is important in the South African economy but the processes of prospecting, extracting, concentrating, refining and transporting the resources have great potential in disrupting the natural environment. The research concentrated on river sand mining which has an adverse impact on the biota and the habitats (Wantzen & Mol, 2013).

Steps in mining sand and gravel in South Africa were given as firstly, finding a mining location and removal of vegetation and topsoil using excavating equipment. The second step involves extraction using a dredging machine to suck the resources. Thirdly, a separator is used to separate sand and gravel from large rock particles, while fine sand is removed from coarse sand (Asabonga et al., 2017). In the end, usually, excess sand is returned to the pit using a discharge pipe (Hill & Kleynhans, 1999). Methods of mining were noted as dry pit mining is done when sand is extracted from the dry streambed. Wet pit mining involves removing sand and gravel below the water table using hydraulic machines while bar skimming is when the top layer of soil is removed (Hill & Kleynhans, 1999).

Looking at a case study of the Wild Coast in the Eastern Cape in the villages of Chwebeni; Mngazi and Coffee Bay; there are currently more than 200 small to medium size ‘sand mining sites that are beginning to have a devastating environmental impact. Socio-economic effects are an amalgam form of environmental, social and economic factors. It is vital to note that quantifying the socio-economic effects is difficult given that sand mining habitually operates illegally. That would help in decision making as development can only be achieved through sand mining for construction purposes of modern structures. Sand mining activities have affected, in one way or another, the economic, social and environmental aspects of man in mining areas. However, many people resort to the trade of sand to earn a living. Since sand mining has economic gains, most community and traditional leaders sell community lands within their domains to miners. This is done because people derive their livelihoods from sand mining to ensure their survival from the natural resources available and accessible to

them. This situation is due to an increase in demand for sand for construction purposes, but this also places enormous pressure on the environment.

The mining of natural aggregates such as sand serves as the main source of construction aggregate used throughout the world. However, operations of sand mining whether small- or large-scale are disruptive to the environment. The activity creates employment for youth and adults with youth being hired as sand loaders and adults mainly used as truck drivers. Sand and gravel mining leads to an improvement in road networking systems. This improves the quality of access roads from gravel to tar roads. The discovery of human remains in the sand mining sites is amongst the social impact that was highlighted in the study. However, the communities react to the challenges through impact minimization strategies that include the use of rocks and tree branches to fill up holes in damaged roads whilst on the other hand, others invited authorities to intervene on matters that arise to be beyond their powers. The study then calls for a holistic approach in community resource management.

According to Saviour (2012), sand mining is the extraction of sand, mainly through an open pit but sometimes mined from beaches and inland dunes or dredged from ocean and riverbeds. It was found in one of the case studies that the settlements along the Witwatersrand initially started to provide housing for miners. Thereafter, other supporting industries were established which attracted people of diverse occupations and infrastructure was developed including roads, railway lines, telegraph, electricity, gas and water supply. Within a few months these settlements grew from mine camps to shantytowns and ultimately to municipalities where schools, hospitals and businesses opened their doors. Some of these towns grew into cities, in the case of Johannesburg, within a few decades. This was also supported by Pieterse (2017) that sand mining has become free for all in the rural communities which leads to more development taking place in various communities. According to Pieterse (2017), the residents consist of not only a cross-section of the ethnic groups of South Africa but also people from other African countries such as Lesotho, Swaziland, Botswana, Zimbabwe, Mozambique, Malawi and Zambia. It was also noted that the squatter camps sprung up in the open spaces between the towns as poor people from rural areas and neighbouring countries flocked to the cities, and more particularly to the mines and other industries in the hope of finding work.

Madyise (2013) defines sand mining as the extraction of sand from beaches or the dredging of sand from riverbeds, which is performed mainly through open pit methods. It is important to note that without the regulation systems, people in the sand supply business said it is difficult to determine what is legal and what is not. In Pietermaritzburg, the illegal sand mining along the banks of the Msunduzi and Umngeni rivers between Pietermaritzburg and Durban is posing an increasingly serious environmental threat. The case study shows how the Witness began investigating the illegal operations after being made aware by an avid hiker of an illegal sand mining operation at Table Mountain. According to Pieterse (2017), subsequent inquiries revealed that similar illegal sand mining is taking place regularly along the banks of the two rivers between Table Mountain and Inanda.

Saviour (2012) said that after illegally excavating the sand, the illegal operators just leave, abandoning the ravaged land without rehabilitating it. One particular site, which is thought to have been in operation since the beginning of December 2014, is on the banks of the Duzi in the Table Mountain area. The operation has destroyed the vegetation in the area, leaving it in a “huge mess”, according to Nthambi and Orodho (2015). Pieterse (2017) states that the impact of vegetation clearing and formation of access routes to sand mining sites for large vehicles has probably the most profound effect on erosion and land degradation. With sand mining, most of the topsoil is removed and vegetation becomes absent. Water penetration is low and run-off is high. Sand mining subsequently leads to a hastened soil erosion process. According to Madyise (2013), sand mining activities causes various environmental impact on the environment. However, it was noted that in KwaZulu-Natal province, various legislative policies have been put in place to manage the activities that happen during sand mining practices. In KwaZulu- Natal Province, the Ingonyama Trust Act (Act 3 of 1994) established the Ingonyama Trust Board (ITB) and gives it the mandate to administer the affairs of the Trust and the Trust land. It is important to note that sand mining activities must be regulated and this includes the authority to decide on affairs regarding lease, alienation or other disposal of any Trust land. However, this does not exempt the ITB and Traditional Council or rural residents from adhering to requirements of National, Provincial legislation or Local Authority by laws.

Section 24 of the Constitution of the Republic of South Africa guarantees everyone a right to an environment that is not harmful to their health and well-being, and to have the environment protected for the benefit of present and future generations. This section also places a constitutional mandate on Government to protect the environment through reasonable legislative and other measures that:

- Prevent pollution and ecological degradation;
- Promote conservation; and
- Secure ecologically sustainable development and the use of natural resources while justifying economic and social development.

In order to give effect to this right and fulfil its constitutional mandate, Government enacted the National Environmental Management Act 1998 (Act No. 107 of 1998) and the Specific Environmental Management Acts (SEMAs) for example the National Environmental Management: Waste Act, National Environmental Management: Biodiversity Act. The Democratic Alliance (DA) (the current official opposition party in the Eastern Cape) called upon the Minister of Mineral Resources to act swiftly and decisively to put a stop to what it called the illegal mining of sand in the Eastern Cape. It was also indicated by Pieterse (2017) that sand mining is in effect a free for all activity, according to DA Eastern Cape Shadow Member of the Executive Council (MEC) for Economic Development, Environmental Affairs and Tourism. If the African National Congress (ANC)-led government of the province is serious about stopping corruption and lawlessness, then they should put their money where their mouths are and act without delay to end the illegal mining which is desecrating the dune and estuarine formations along the Wild Coast.

Kori and Mathada (2012) add that despite many attempts by the DEDEAT to engage with the Department of Mineral Resources (DMR) regarding unauthorized sand mining along the Wild Coast, particularly through Operation Phakisa, their efforts have largely been in vain as the DMR has seldom honoured the joint operations that have been arranged in this regard. The responsibility for enforcing the NEMA Act 107 of 1998, falls squarely on the DMR because sand is a mineral, which was according to the DA in the Eastern Cape. However, the response by the ANC-led government in the Eastern Cape alleged to be understaffed in the province and thus the illegal sand

mining activities continue unabated and have effectively become a free-for-all. As a result, ancient and stable dune formations have been desecrated and are already impacting negatively on the structure of some beaches and estuary mouths along the Wild Coast section of the Eastern Cape. Pieterse (2017), proposes that the only way that Environmental law enforcement can enforce any law is through the Integrated Coastal Management Act relating to illegal off-road driving by sand miners. It is a well-known fact that it is equally an undisputable matter that economic development activities if not well regulated can plunge many countries into environmental disasters (Paulse, 2016).

3.2.2.1 Positive impact of sand mining and gravel extraction

Sand and gravel has been a useful natural resource for thousands of years worldwide and is fundamental to human existence (Madyise, 2013). The demand for sand and gravel has increased (Hamid, Kadir, Kamil & Hassan, 2018). Mining operators in conjunction with resource agencies need to work hard and make sure the extraction is completed responsibly (Hamid et al., 2018). Madyise (2012) discussed sand and gravel as crucial resources to economic development activities when making aggregate in South Africa. Development is a process of adding improvements to a piece of land such as grading, drainage and access roads (Hamid et al., 2018). Pit sand is mixed with cement to form concrete, mortar and plaster for the construction of strong structures (Hamann, 2012). Mining of gravel sand and river sand has been done for road and cement cluster for centuries worldwide. This statement was supported by Kondolf (2008) who states that the use of active channel deposits like river sand and gravel sand is desirable for construction cluster. This is due to that they are durable, well sorted and frequently located near the people who need sand and transportation routes. Besides, gravel sand and river sand being useful resources in the construction industry, the resources are useful tools in flood control, building houses and river stabilization, in aggrading rivers since most reservoirs are not aggraded in developed countries.

Sand mining helps to de-silt rivers that contain a lot of sand, which also help increase the river's depth and flow (Chimbodza, 2012). Sand mining in many parts of the world is viewed as an important resource in the construction of buildings and economic development. Bagchi (2010) notes that gravel sand mining is useful in landscaping

projects which beautify gardens. Gravel sand and river sand are important in the construction and manufacturing industries when used in building, making glass, electronic chips and ceramics although this is very common in the developed countries. Furthermore, most African countries are still developing and benefit from the use of natural resources such as gravel sand and river sand mining for economic development and South Africa is no exception (Kesler, Simon, & Simon, 2015). Every citizen could afford to build a better house but to do so sand is required to build or construct the house which then strengthens the importance of sand mining. Sand mining had led to the development of better infrastructure all over the world looking at all the buildings and roads we enjoy today as a result of sand mining (Mwangi, 2007). This led to a better socio-economic life for rural people and improvement of the standard of living infrastructure wise. This is supported by Mbaiwa (2008) as a positive impact of sand mining in Botswana where more land had been used to develop infrastructure in the form of shopping malls and residential areas. Zimbabwe is not an exception in benefiting from sand mining through infrastructural development (Lupande, 2012).

There is the creation of employment for families at mining sites in every region that sand mining takes place. This creation of employment to locals is for people who are above eighteen years as manual loaders at mining sites and some are employed as truck drivers. Sand mining activities generate revenue and income to local governments and landowners in Africa's developing nations, which alleviates poverty, but with a condition, only if the sand mining is legal. Often at times in the developing countries in the African continent, illegal sand mining is at its peak, therefore, it robs the governments of revenues. This is noted by Lawal (2011) in the Niger State of Nigeria where financial benefits from mining work show that local government earn about 80% of total profits from the business while the miner gets about ninety-two per cent of accrued revenue.

3.2.2.2 The negative environmental impact of sand mining in South Africa

Sand and gravel are important natural resources in economic development but the continuous removal has adverse effects on the environment (Vopel, Pook, Wilson & Robertson, 2017). The sand and gravel are mined worldwide and account for the largest volume of solid material extracted globally and the highest volume of raw

material used on earth after water (about 70-80% of the 50 billion tonnes material mined/year). Formed by erosive processes over thousands of years, they are now being extracted at a rate far greater than their renewal (Muhammad et al., 2011; Saviour,2012; Vopel, et al., 2017). The negative environmental impact seems to outweigh the positive effects of mining worldwide. Despite our increasing dependence on the colossal quantities of sand and gravel being used and the significant negative impact that their extraction has on the environment, this issue has been mostly ignored by policy makers and remains largely unknown by the public. Consequently, a large discrepancy exists between the magnitude of the problem and public awareness of it (Graham, 2018).

The amount being mined is increasing exponentially, mainly because of rapid economic growth in African countries and the resulting boom in construction. A conservative estimate of 40 billion tonnes per year for the world consumption of aggregates is twice the yearly amount of sediment carried by all of the rivers of the world (Merem, Twumasi, Wesley, Isokpehi, Shenge, Fageir, & Ochai, 2017). Cement demand by China has increased exponentially by 430% in 20 years, while use in the rest of the world increased by 60%. Surprisingly, reliable data on their extraction in certain developed countries are available only for recent years. Sand was until recently extracted in land quarries and riverbeds; however, a shift to marine and coastal aggregates mining occurred due to the decline of inland resources (Jonah, Agbo, Agbeti, Adjei-Boateng, & Shimba, 2015; Schlacher et al., 2016). River and marine aggregates are now the main sources for building and land reclamation. Tourism can be affected by beach erosion. Sand is often removed from beaches to build hotels, roads and other tourism-related infrastructure. In some locations, continued construction is likely to lead to an unsustainable situation and destruction of the main natural attraction for visitors, the beaches themselves. Fishing both subsistence and commercial can be effected through the destruction of benthic fauna and agriculture could be affected through loss of agricultural land from river erosion and the lowering of the water table (Cooke & Cowx, 2006).

The insurance sector is affected through exacerbation of the impact of extreme events such as floods, droughts and storm surge through decreased protection of beaches. Moreover, sand mining results in the erosion of coastal areas and beaches. This

affects houses and infrastructure as a decrease in bed load or channel shortening can cause downstream erosion including bank erosion and the undercutting or undermining of engineering structures such as bridges, side protection walls and structures for water supply. Sand mining and gravel extraction are very important activities for economic development in both developed and developing world (Gavriletea, 2017). Generally, mining disturbs land surface areas, leaving huge open pits which are difficult physically and economically to rehabilitate at the time mining cease. Excessive mining leads to depletion of resources on both riverbeds and open lands. Extraction has an impact on biodiversity, water turbidity, water table levels, landscape and climate. There are also socio-economic, cultural and even political consequences. The problem is now so serious that the existence of river ecosystems is threatened in several locations, the damage being more severe in small river catchments (Nguru, 2007; Vopel, et al., 2017; Graham, 2018). The same applies to threats to benthic ecosystems from marine extraction.

The environmental impact of unsustainable sand mining could result in soil erosion, sinkhole formation and the loss of biodiversity, as well as the contamination of soil, groundwater and surface water. These activities also cause destruction and disturbance of ecosystems and habitats and in areas where there is a high water table; it might disturb or destroy productive grazing and croplands and contaminate natural waterbodies (Pitchaiah, 2017). Even though sand miners can operate on a small scale specifically in rural communities, they removed important ecology (riparian) stabilising vegetation. This vegetation helps to reduce erosion by holding soil in place, protects the water quality by filtering sediments and pollutants, and provides a habitat for wildlife (Dacosta & Mathada, 2017). The mining of aggregates in rivers can affect pollution and change the level of water acidity. Removing sediment from rivers causes the river to cut its channel through the bed of the valley floor (or channel incision) both upstream and downstream of the extraction site (Yen & Rohasliney, 2013; Lusiagustin & Kusratmoko, 2017). This leads to coarsening of bed material and lateral channel instability. It can change the riverbed itself. Incision can also cause the alluvial aquifer to drain to a lower level, resulting in a loss of aquifer storage. It can also increase flood frequency and intensity by reducing flood regulation capacity (Hill & Kleynhans, 1999). However, lowering the water table is most threatening to water supply, exacerbating

drought occurrence and severity as tributaries of major rivers dry up when sand mining reaches certain thresholds.

Sand and gravel mining also have a climate impact. They have a direct impact through greenhouse gas emissions from both the extraction process itself and the transport, sometimes over long distances of the mined materials. It also has an indirect impact on the production of cement for use in concrete together with sand and gravel: for each tonne of cement, an average of 0.9 tonnes of carbon dioxide are produced (Ripple et al., 2017). Emissions of 1.65 billion tonnes of carbon dioxide were estimated from cement production in 2010 alone and total carbon emissions from cement amount to about 30 billion tonnes of carbon dioxide (Bayram, 2015). The absence of global monitoring of aggregates extraction undoubtedly contributes to the gap in knowledge, which translates into a lack of action. When looking at South Africa, most of the sand mining operations in South Africa are taking place in the Eastern Cape and KwaZulu-Natal, with more than 200 mines active in these provinces (Docosta & Mathada, 2012).

It is assumed that 90% of the sand mining in these above-mentioned provinces are illegal sand mining. This suggests that illegal sand mining results in deep and wide pits on the riverbed and these pits, which affect the natural flow of water into the river in these two provinces namely Eastern Cape and KwaZulu-Natal (Docosta &Mathada, 2012; Pillay, Naidoo, Bissessur, Agjee, Pillay, Purves, & Ballabh, 2014; Graham, 2018). Recently, there has been an increase in the sand mining activities taking place in the Limpopo Province. This is because the province has a high demand for sand for infrastructural purposes as there is an increase in the standard of living more especially looking at the building of houses. Impact include bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability (Asabonga et al., 2017). These physical impact cause degradation of riparian and aquatic biota and may lead to the undermining of bridges and other structures. Sand mining also affects the adjoining groundwater system and the uses that local people make of the river (Pillay et al., 2014). The impact of sand mining that normally takes place in South Africa can be broadly classified into three categories:

3.2.2.3 The physical impact of sand mining

The large-scale extraction of streambed materials, mining and dredging below the existing streambed, and the alteration of channel-bed form and shape leads to several impacts such as erosion of channel bed and banks, increase in channel slope, and change in channel morphology (Pillay et al., 2014). Such impact may cause undercutting and collapse of riverbanks, loss of adjacent land, and lastly, upstream erosion because of an increase in channel slope and changes in flow velocity. It might also cause downstream erosion due to the increased carrying capacity of the stream, downstream changes in patterns of deposition, and changes in channel bed and habitat type.

3.2.2.4 Water Quality

Mining and dredging activities poorly planned stockpiling and uncontrolled dumping of overburden, and chemical fuel spills will cause reduced water quality for downstream users, increased cost for downstream water treatment plants and poisoning of aquatic life (Saviour, 2012). The mining of aggregates in rivers can have an effect on pollution and change the level of water acidity (Peduzzi, 2014). Removing sediment from rivers causes the river to cut its channel through the bed of the valley floor (or channel incision) both upstream and downstream of the extraction site. This leads to coarsening of bed material and lateral channel instability (Peduzzi, 2014). It can change the riverbed itself. Incision can also cause the alluvial aquifer to drain to a lower level, resulting in a loss of aquifer storage. It can also increase flood frequency and intensity by reducing flood regulation capacity. However, lowering the water table is most threatening to water supply, exacerbating drought occurrence and severity as tributaries of major rivers dry up when sand mining reaches certain thresholds. The mining of marine aggregates is increasing significantly and although the consequences of substrate mining are hidden, they are tremendous (Peduzzi, 2014). Marine sand mining has an impact on seabed flora and fauna. Dredging and extraction of aggregates from the benthic (sea bottom) zone destroy organisms, habitats and ecosystems (Peduzzi, 2014). It deeply affects the composition of biodiversity, usually leading to a net decline in faunal biomass and abundance or a shift in species composition. Long-term recovery can occur only where the original sediment composition is being restored. Aggregate particles that are too fine to be used are

rejected by dredging boats, releasing vast dust plumes and changing water turbidity, resulting in major changes to aquatic habitats over large areas.

3.2.2.5 Ecological

Mining, which leads to the removal of the channel substrate, resuspension of streambed sediment, clearance of vegetation, and stockpiling on the streambed, will have an ecological impact (Saviour, 2012; Vopel, et al., 2017; Graham, 2018). Such impact may have an effect on the direct loss of stream reserve habitat, disturbances of species attached to streambed deposits, reduced light penetration, reduced primary production and reduced feeding opportunities (Saviour, 2012). Stream ecosystems draining agricultural or mining areas are often severely impacted by the high loads of eroded material entering the stream channel; increasing turbidity; covering instream habitat and affecting the riparian zone, and thereby modifying habitat and food web structures. The biodiversity is severely threatened by these negative effects as the aquatic and riparian fauna and flora are not adapted to cope with excessive rates of erosion and sedimentation (Saviour, 2012). Pesticides or heavy metals that have an aggravating effect on functions and ecosystem services may also pollute eroded material. The magnitude and direction of these impact vary among different levels of eco-logical complexity. Invasive plants can directly affect native plants by monopolising the use of limited resources as well as changing the ecosystem by altering soil stability and thus promoting soil erosion (Pillay et al.,2014).

Loss of vegetation is amongst the other impact of sand mining as evidenced in the present study. Loss of vegetation is normally associated with an increase in the human population and rapid economic development. Millions of animals and plants are killed directly when native vegetation is cleared (Twesigye, Onywere, Getenga, Mwakalila, & Nakirada, 2011). Clearing of vegetation affects species through loss of habitat. Vegetation clearing affects eco-system processes and services. The removal of vegetation contributes to soil erosion by water and wind, leading to declines in water quality (Brooks, et al. 2004).

3.2.3 The impact of sand mining on land degradation

There is a high demand for sand due to the ever-increasing building construction projects and other infrastructural developments. Sand is a valuable resource for

construction and other purposes, however, sand mining often results in serious environmental problems such as land degradation, loss of agricultural land, biodiversity and as well as increased poverty among people (Kori & Mathanda, 2012). Underdeveloped and developing countries, where governments often lack the capacity to establish and enforce environmental regulations, are usually confronted with illegal sand mining operations, leading to a series of environmental issues and threats (Gleitsmann, Kroma, & Steenhuis, 2007). Land degradation refers to human practices and technologies that extract or degrade the land's resources faster than they can be replenished and thus fail to ensure the long-term sustainability of the environment or land.

3.2.4 Sand mining in rural communities

Sand mining and its associated activities serve as a source of livelihoods for the communities whilst on the other hand, it causes environmental degradation especially in the rural areas of South Africa. According to Stebbins (2006), sand mining activities have impacted, in one way or another, the economic, social and environmental aspects of man in mining areas. However, many people resort to the trade of sand to earn a living. Since sand mining has economic gains, most communities and traditional leaders sell community land within their domains to miners. This is done because people derive their livelihoods from sand mining to ensure their survival from the natural resources available and accessible to them (Madyise, 2013). This situation is due to the demand for sand for construction purposes, but this also places enormous pressure on the environment (Onwuka, Duluora & Amaechi, 2013). According to Madyise (2013), sand mining is one of the direct and obvious causes of environmental degradation. Sand is one of the construction materials with high economic value as it is used for construction purposes such as the building of malls, schools, health facilities and roads. According to Mngeni, Musampa & Nakin (2017), sand mining activities are a threat to the environment. The demand for sand is increasing because of its importance and role in construction are indispensable. Extraction of sand is more likely to have ramifications around the environments of their occurrence (Onwuka, et al., 2013).

Sand is used for all kinds of projects such as land reclamation, the construction of artificial islands and coastline stabilization and these projects have economic and

social value, but sand mining can also bring environmental problems. Madyise (2013) affirms that sand like diamonds is natural resources highly demanded in construction industries which affect the surrounding communities and the environment at large. Some of the important aspects of sand include: strengthening buildings when mixed with cement and concrete; plastering; mixing with concrete when making foundations; and moulding bricks for the building of homes and rental houses which brings income to villagers (Brebbia, Zubir & Hassan, 2017). Villagers build modern and durable houses at cheap cost because of the availability and accessibility of sand.

3.3 The nature of land degradation

This sub section focused on land degradation and the causes of land degradation.

3.3.1 Land degradation in South Africa

This is a composite term that has no single identifiable feature that describes how one or more of the land resources such as soil, water, vegetation, rocks have changed for the worse (Paulse, 2016). A landslide is often viewed as an example of land degradation in action because it changes the features of the land, causes the destruction of houses and disrupts activities (Kori & Mthanda, 2012). There are various main causes of land degradation such as the overgrazing of rangeland, over-cultivation of cropland; waterlogging and salinization of irrigated land; deforestation; pollution and industrial causes (Kori & Mthanda, 2012). There are legislative frameworks that are used as a set of rules or guidelines that can be put in place to solve certain problems that have occurred or can occur such as the environmental problems. There are legislative frameworks to regulate sand mining in the country. It is significant to adhere to the legislative framework to be able to mitigate the environmental issues. Numerous environmental acts are being implemented to ensure that sustainable development is achieved always to avoid compromising the needs of the future generations. The aim of the environmentalists is to ensure that these limited resources are utilized in a proper manner to avoid the negative environmental impact (Madyise, 2013). These various legislative frameworks are used as tools to govern sand mining activities to prevent such land degradation issues in South Africa.

It is equally an undisputable fact that such economic development activities if not pursued responsibly can plunge many countries into environmental disasters.

According to Paulse (2016), on 08 March 2016, the South African Department of Mineral Resources announced its intention, to begin with, the exploration of shale gas in the Karoo region. According to the government, fracking for shale gas in the region would be an economic boost for the country in terms of providing energy security for the country, economic growth and employment. However, the announcement was met with hostility from the anti-fracking campaigners known as Treasure Karoo Action Group (TKAG) who threatened to take the government to court if it continued with the fracking plans. According to Paulse (2016), the Treasure Karoo Action Group believes that fracking uses huge amounts of water, which must be transported to the fracking site at a significant environmental cost. Furthermore, it emphasized that potentially hazardous chemicals used may escape and contaminate groundwater around the fracking site. This is, but one of the examples of the great divide between those who are for exploitation of natural resources for economic gains and those who are against this intending to protect the environment (Gleitsmann et al., 2007).

3.3.2 Land degradation in rural communities

According to Hamann (2012), land degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land. It is viewed as any change or disturbance to the land perceived to be deleterious or undesirable. Natural hazards are excluded as a cause; however, human activities can indirectly affect phenomena such as floods, bushfires and other related activities. The majority of the countries in the Southern African region largely depend on agriculture for their livelihood. An exception can be made to countries like Mozambique, Lesotho and Swaziland (Kingdom of eSwatini); the large areas of Southern Africa are arid or semi-arid (Bond, Venkataraman, & Masera, 2004; Msangi, 2007). Hence, the soil is generally poor with low organic matter content, which makes the soil an easy target for soil miners. Land degradation is often difficult to comprehend or to single out one factor as the cause of land degradation in the rural communities, more especially in African rural communities. This is because there are several factors that constitute land degradation. These factors include natural soil erosion, vegetation clearance, landslide levels, overgrazing and sand mining, but sand mining is the one that causes irreversible damage as compared to the other factors.

The impact of sand mining on rural communities is easy to note, as it happens instantly and apparent. Looking at Zimbabwe, it is estimated that more than 20billion tonnes of soil get mined in Zimbabwe per year (Madyise, 2013; Ncube-Phiri et al., 2015), and leaves the environment to be disastrous prone to flooding and severely degraded. Sand mining might be perceived as a booming business in rural communities as many people try to acquire this resource in order for them to build or construct their houses. This leads to an increased demand for illegal mining places mushrooming all over the area (Mudyazhezha & Kanhukamwe, 2014).

Sand mining in general is an important economic activity in the rural communities employing above the 5% mark of the surrounding communities (Naughton-Treves, Holland, & Brandon, 2005). However, there is poor implementation of the sand mining laws. As a consequence, this profound activity turns to be a devastating activity to the environment as people do not engage in mining activities in a sustainable manner. As a consequence, there is no rehabilitation of the areas when done. Land degradation is mainly caused by poorly managed sand mines and this is supported by other researchers across the globe (Nana-Sinkam, 1995; Kitula, 2005; Asabonga et al., 2016; Harald, 2017). The land degradation taking place in the communities poses a threat to the agricultural system.

3.3.3 Causes of land degradation especially in the context of rural communities

There are various causes of land degradation in the context of rural communities but for the purpose of this study, there are only three causes of land degradation that will be discussed.

3.3.3.1 Agricultural activities

Agricultural activities cause soil erosion and degradation. Erosion commonly occurs following the conversion of natural vegetation to agricultural land, carrying away fertile soil as well as fertilizers, pesticides and other agrochemicals. Agricultural activities produce a diverse range of harmful and beneficial impact on the environmental quality. The community members practice their agricultural activities in the environment for their livelihoods purposes (Walters, Archer, Sassenrath, Hendrickson, Hanson, Halloran, Vadas, & Alarcon, 2016). Thus, the relationship between agricultural activities and the environment is very complex. Unsustainable agricultural practices in

the rural region, in turn, promote land degradation. This is caused by climatic factors such as drought and diminishing rainfall, compounded by anthropogenic factors, including population growth, agricultural intensification and overgrazing. Agricultural land degradation and its result of desertification have been receiving considerable attention from the international community in recent decades. However, the general lack of understanding and awareness about the root causes of land degradation persists, thus the slow progress in reversing the alarming trends of land degradation and land abandonment.

Agricultural activities can have an impact on the environment, which is determined by the production technology and the sand miner's practices in relation to the natural conditions (Madyise 2013). Worldwide, empirical and scientific evidence clearly shows that soil degradation in agricultural land use and decreasing productivity are closely related to the prevalence of mechanical soil tillage, the agricultural method of using mouldboard ploughs, disc harrows, tines, hoes and other mechanical tools to prepare the field for crop production. Agricultural activities take part in an open environment and the various chemicals are used on the ground to grow and sustain the crops. This also has an environmental impact because the chemicals that are often used destroy the type of soil that is on the environment. It is commonly reported that since World War II, communities worldwide have lost around 400 million hectares of agricultural land from degradation, and this loss continues at an alarming rate of about 7 million hectares per year. The agro-ecosystems globally are facing a serious challenge when it comes to reversing the loss and rehabilitating abandoned lands.

3.3.3.2 Deforestation and removal of natural vegetation

According to Hamann (2012), this is the clearing of the ground's forests on a large scale and resulting in many land damages. These factors result in the reduction of vegetation cover, decrease in fallow periods and a reduction in the balance between fallow areas and cultivated fields, which are vital to maintaining soil fertility and reducing losses from erosion. It is important to note that one of the causes of deforestation is clearing the land for pasture or crops. It is of significance to note that the removal of trees causes dangerous fluctuations in temperature (Bagchi, 2010). This is one of the causes of land degradation because trees are removed from the environment. Deforestation of unsuitable land is both a type of degradation as such

and a cause of other types, principally water erosion. It is the leading cause of water erosion in steeply sloping humid environments. It is also a contributory cause of wind erosion, soil fertility decline and salinization.

3.3.3.3 Over-exploitation of natural resources for domestic use

According to Bagchi (2010), this is one of the causes of land degradation and environmental impact. The over-exploitation of vegetation for domestic purposes is one of the environmental effects of land degradation because people over-exploit the resources for their survival. In the rural areas, people do not take into consideration the environmental impact caused by their continued exploitation of resources. It is important to note that people exploit the resources for their domestic use for the fulfilment of their needs (Hamann, 2012). Dasgupta, Deichmann, Meisner, and Wheeler (2005) and Carvalho (2017) carried out a study in trying to establish the relationship between poverty and the environment in Cambodia, Lao PDR, and Vietnam using spatial analysis. They regressed absolute poverty measurement on deforestation, contaminated water, fragile land, indoor and outdoor air pollution. They found a high incidence of poverty in highly deforested areas. They also found a link between poverty and lack of access to clean water caused by environmental degradation. This shows that where the poor are, they mostly indulge in natural resource extraction which is their source of income.

Cavendish (2000), in his study on the relationship between the environment and poverty, showed that incomes from environmental resources significantly contributes to the total incomes of the poor and thus contribute to reducing poverty. Cavendish (2000) in his study postulates that most of the households under study depended heavily on environmental resources with the poor households being much more heavily dependent on environmental resources. The reasoning behind this is simple; the absence of environmental resources can deepen poverty because environmental resources are the main source of livelihood for the poor (Carvalho, 2017). However, caution is made that in the long term, environmental resources could be depleted, which further deepen poverty for the locals who largely depend on these natural resources.

3.4 The effects of sand mining on land degradation

This theme was about the effects of sand mining on land degradation and how sand mining affects land degradation. Stebbins (2006) and Carvalho (2017) suggest that as mining occurs, there is a loss of the protection provided by soil as it cleans out contaminants. Gravel pits are sometimes used as dumping sites with tipper trucks carrying waste to dump as they come to collect sand and gravel. Pollutants from waste filter contaminate drinking water and affect people's health. Saviour (2012) regard the same impact of changing abandoned gravel pits into dumping sites as a serious effect of uncontrolled gravel mining in Kenya. In addition, air and water pollution are also one of the negative effect of sand mining on the environment. Apart from depletion, sand mining can also cause significant damage to the environment, particularly to riparian habitats. Such damage can include land degradation, destruction of vegetation, altering the flow of a river, destruction of river banks, and destruction of wetlands (Saviour, 2012).

There are international treaties signed by different continents like the United Nations Convention on Climate Change (UNFCCC), continental and country-specific legislative frameworks, regulations to control the exploitation of natural resources for economic development. This is done neither to take an extremist one-sided view when it comes to pursuing economic development at the expense of the environment nor environmental matters at the expense of economic development. Land degradation is caused by many factors and one of them is land use mismanagement (O'Mara, 2012). Overuse of land comes because of land mismanagement. Land use mismanagement is caused by a lack of knowledge and results in the depletion of soil organic matter. Land degradation is a huge problem that is persisting in many parts of the world (O'Mara, 2012).

3.5 The legal framework guiding sand mining in South Africa

Mining is of great importance to the South African economy, therefore, it should be recognised that the processes of prospecting, extracting, concentrating, refining and transporting minerals have great potential for disrupting the natural environment (Rabie et al., 1994; Carvalho, 2017). The environment is an area of concurrent national and provincial legislative competence, meaning that both levels of government may

regulate the environmental aspects of sand mining. The main national environmental regulatory authorities are the Department of Environmental Affairs (DEA) and the Department of Water Affairs (DWA), while each province has a department responsible for environmental matters. Both levels of authority use the National Environmental Management Act of 1998 (NEMA) to regulate certain environmental aspects of sand mining.

3.5.1 National Environmental Management Act (Act NO.107 of 1998)

Sand mining is an activity that can result in the disturbance of ecosystems, loss of biological diversity, pollution and degradation of the environment (Syah & Hartuti, 2018). The main aim of this Act is to provide for co-operative environmental governance by establishing principles for decision making on matters affecting the environment. Everyone has the right to have the environment protected for the benefit of the present and the future generations through reasonable legislative frameworks and other measures that prevent pollution and ecological degradation. This legislation promotes conservation, secure sustainable development and the use of natural resources while promoting justifiable economic and social development (Madyise, 2013; Mattamana, Varghese & Kichu, 2013). According to Kori and Mathada (2012), despite legislative frameworks, policies and regulatory mechanisms put in place by the government to regulate sand mining activities; adherence to these mechanisms is still a challenge. Informal sand mining activities continue unabated.

The researcher believes that with training and educational programmes specifically meant to educate and train informal sand miners on the impact of their activities on the environment can generate a balance between economic benefits arising from sand mining, development and environmental protection. Thus, rehabilitation is also one of the strategies that can be used to ensure that such environmental impact is mitigated.

It is also substantial to note that having legislation in place alone cannot regulate the sand mining activities. Miners may not even know the existence of such legislation and what they mean to them. They only harvest the sand and gravel which often result in environmental and health risks for the communities (Madyise, 2013). As a result, the open pits are often used by communities as dumping sites that pollute the land while the pits are flooded during rainy seasons and become a conducive breeding

ground for mosquitoes and other water-borne diseases (Darko, 2014). This also exacerbates the drowning of children who swim inside these deep holes that usually have water. Moreover, the researcher proposes that the stakeholder briefings can also be one of the alternatives to ensure that the sand miners are encouraged of the rehabilitation process after the practice of sand mining.

The environmental effects caused by the mining of sand from a river or valleys, is no exception, often causing adverse impact to biota and their habitats. As stated in the White Paper on a National Water Policy for South Africa (Department of Minerals & Energy, 1998), effective resource protection requires two separate sets of measures. The first is resource directed measures, which set clear objectives for the desired level of protection for each resource. The second is source directed controls which aim to control what is done to the water resource by way of registration of sources of impact, standards for waste discharges, best management practices, permits and impact assessments so that the resource protection objectives are achieved.

The legal requirement for sand mining in terms of the National Water Act (NWA), 36 of 1998 in terms of section 21 of the NWA, in-stream mining of sand is a water use activity and requires authorisation in terms of section 22 of the NWA (Hayes, 2016). The water uses related to sand mining are the following Section 21 (c) of the NWA stated that impeding or diverting the flow of water in a watercourse lead to altering the bed, banks, course or characteristics of a watercourse, in terms of Government Notice No. 704 of 4 June 1999 in terms of NWA (Hayes, 2016). No person may extract sand, alluvial minerals or other materials from the channel of a watercourse or estuary unless reasonable precautions are taken to ensure that the stability of the watercourse or estuary is not affected by such operations, prevent scouring and erosion of the watercourse or estuary which may result from such operations or work incidentally. Every person obtaining sand, alluvial minerals or other materials from the bed of a watercourse or estuary must construct treatment facilities to treat the area to the standard prescribed in Government Notice No. R.991 dated 26 May 1984 as amended or by any subsequent regulation under the Act before leaving or closing the site.

3.6 Sand mining and rehabilitation in South Africa

This theme dealt with the significance of rehabilitation in sand mining in South Africa with regard to rural communities taking into consideration the high increase in the demand for sand for development. The mining of sand in South Africa is rapidly growing to sustain an increasing demand for sand for building purposes. Although mining of sand is regulated by environmental legislation, such as the National Environmental Management Act 107 of 1998 (NEMA), previous poor mining practices have left areas of land degraded and vulnerable to erosion. These areas need to be rehabilitated and this can be done by restoring the vegetation and habitats to a natural state. Sand mining is the process of removing sediment in the form of sand and also gravel that had accumulated in the river of streambeds over the geological time scale (Thornton et al., 2006). According to Dashwood (2012), mining activities operate at the expense of the greater communities. Such mines have no or few rehabilitation strategies and such activities may cause disturbing effects on the environment, such as uncontrolled erosion and land degradation.

According to Desai and Jarvis (2012), sand mining is significant in the South African economy and has expanded rapidly to make up a third of the total revenue produced in the sand and aggregate economic sector. Increasing development of housing, business parks and planned economic infrastructures, such as the construction of the Gautrain, 2010 Soccer World Cup sports grounds and other government infrastructural facilities, had a boost in the demand for sand (Dashwood, 2012). As the need for sand production in South Africa grows, the mining of sand needs to expand and take place on a larger scale. The mining of sand takes place in open pits and causes damage to the underlying soil. Rehabilitation of mined sites is in any case a legal requirement, enforced by South African legislation such as the National Environmental Management Act 107 of 1998. The NEMA 107 of 1998 requires that sand mines should make a provision for topsoil availability in rehabilitation. It is important to note that degradation due to sand mining should be avoided and proper rectification of degraded land needs to take place to ensure that erosion is stopped or minimized.

In South Africa, according to SAIIA (2014), there are at least two departments that can tackle illegal sand mining. Further, sand mining can be regulated at national and provincial level. In order to rehabilitate areas where sand mining has occurred,

Goddard (2007) proposes that there should be what he termed as the reference state. That is an acceptable physical and biological damage that can be easily be mended for use in other purposes. Goddard (2007) states that there should be a sand budget. At this level, one can determine how much sand should be extracted without causing environmental degradation and other associated consequences such as bank failure. Because sand extraction methods have important repercussions for the degree of degradation, it is recommended that the sand budget takes into cognisance extraction methods because mechanical methods of sand extraction were found to be the major cause of excessive extraction behaviours, particularly for cluster two and cluster three sand mining sites.

Secondly, Gondo, Mathada and Amponsah-Dacosta (2019) point out that sand mining should be monitored as this will help to prevent excessive extraction behaviours. This will also improve environmental management plans. Such comprehensive environmental management plans should be implemented by sand miners as a matter of compliance. Gondo et al. (2019) also propose a comprehensive environmental management system that controls all sand mining operations. The existence of 'comprehensive environmental management systems' may ensure that the welfare and well-being of the current generation are promoted without compromising the quality of life of future generations (Vintró et al. 2014). The companies that are involved in sand mining should be in a position to be able to effectively anticipate the environmental problems and secure support from both local people and the government. (Azapagic, 2004).

Other scholars have also noted that most companies only comply with environmentally friendly practices when if such actions are matters of compliance with existing laws or regulations (Driussi & Jansz, 2006; Kapelus, 2002 and Carvalho, 2017).

The absence of laws binding the sand mining companies to environmentally friendly practices have resulted in non-compliance. Furthermore, Gondo et al. (2019) advance that as an addition to the environmental management system, a code of conduct needs to be established which will punish the offenders and reward the ones that comply with the rules. Moreover, the local government should take advantage of the income generated through the licensing of sand mining activities and train local people about environmental friendly activities. Environmental awareness and training may

also help in calculating a culture of environmental consciousness by sand minors and the surrounding communities at large. The need to adopt sustainable practices in the sand mining business should be the main emphasis in such training and environmental awareness programmes (Gondo et al., 2019).

In the long term, it is recommended that alternative inputs to the construction industry should be explored so that demand for sand is reduced. For instance, Kuttipuran (2006) and Gavriletea (2017) have noted that reliance on concrete structures in the construction industry can be lowered if households are encouraged to use wood as an alternative resource. Other long-term measures would include exploring other employment generation methods so as to limit the involvement of communities in sand mining activities.

3.7 Summary and Conclusion

In summary, this literature review looked at various components of the research in relation to the objectives of the study. This included aspects such as the nature of sand mining, the nature of land degradation, the effects of sand mining on land degradation and the significance of rehabilitation in sand mining. Lastly, the literature review provided to reflect the debates on sand mining, land degradation and the significance of rehabilitation in rural areas. There is thus a need for regulating sand extraction in both national and international waters and it should be authorized only after sound scientific assessment shows there would be limited impact on the environment. Greater consideration of substitute and sustainable use of the resource could drastically reduce the impact on the environment. Other policy actions include the introduction of scientific mining operations, followed by ecological restoration.

Sand mining contributes to the construction of buildings, infrastructure development; it helps in extracting minerals and provides both economic and social benefits. However, intensive sand mining with disregard to environmental protection erodes these gains and creates a series of environmental problems. The regulatory agenda prepared for sand mining is passive and this make enforcement complicated. Lack of clear guidelines for dealing with sand mining operations coupled with the inability of the regulatory authorities' results in unscrupulous sand mining activities and environmental degradation.

Even though there are no specific guidelines followed as of now, it is suggested that local municipalities come up with bylaws to help preserve the ecological beauty of their areas. Environmental awareness training should be conducted for the communities in the vicinity of the extraction sites, there should be a clear check maintained on the bodies, so that there is fear of illegal sand mining. This would assist in monitoring and enforcement of the bylaws made for the development of society. Studies focusing on the impact of sand mining on water quality, and the land affected by it, should also monitor the damage caused due to sand mining. This would assist the community and the government authorities to know and understand the nature and severity of the impact of sand mining on water quality in the area. The chapter that follows will focus mainly on the research methodology where the different methods will be used to collect data and analyse the data.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This section presents an overview of the research methodology employed in this study. The section covers the following: the research design, population, the study sample and size, sampling procedure, data collection and analysis method. The research ethics are discussed in the last part of the section. The section also highlighted the background of the study, the scope of the study and the discussion based on the study area that is employed in the research. Data was collected from the Mentz Village community between December and January 2017/18 in Capricorn District Municipality of the Limpopo Province. Mentz Village is an area where development is taking place at a speedy rate. The demand for sand is increasing due to the construction of houses and the need for infrastructural development.

4.2 The scope of the study

The study was conducted to investigate the impact of sand mining on land degradation and the significance of rehabilitation in Mentz Village. In order to gather relevant data, the researcher explored questions such as: how does sand mining have an impact on land degradation and rehabilitation? From the general research question, specific questions were formulated for instance these questions sought to discover the nature of sand mining and land degradation; secondly the impact of sand mining on land degradation and lastly the significance of rehabilitation in sand mining. This was a mixed research study, meaning, it used both qualitative and quantitative approaches. In order to realise the objectives of the study, the research used in-depth interviews and survey questionnaires to collect data. This was done satisfactorily until data was well collected. Data was collected from the community members, the Chief and the sand miners. The study had few limitations, for instance, it was conducted at one small community, which was Mentz Village, hence, its findings may not be generalised to refer to South Africa or Limpopo as a whole.

4.3 Study area

Mentz Village is a rural area in South Africa, located in the Limpopo Province under Polokwane Local Municipality which is within the Capricorn District Municipality. Mentz Village is divided into six (6) sections, which are Mshengoville, Badimong, Malesa, Segoreng, Mashemong and Ga-Shiloane. The area is located approximately 5 kilometres away from Mankweng Township and the University of Limpopo. The village is characterised by sand mining projects whereby they deliver gravel sand and river sand. The main aim of these projects is to make a profit without considering the environmental challenges or impact because of the high demand for sand due to the increase in development. It is an area where there is residential expansion and the demand for sand is increasing at a very fast pace. Thus, these sand mining projects grow and develop because there is a high demand from the residents as well as when there is a building of huge structures, for example, the University of Limpopo seems to be the most benefiting from Mentz Village sand mining projects.

4.4 Research design

The researcher adopted a mixed methods research for this study. According to Williamson (2005), the purpose of mixed methods is to achieve diverse but corresponding data on a similar topic to bring differing strengths and to minimise the weaknesses of both qualitative and quantitative research methods. According to Guba, Lincoln and Denzin (2011), mixed methods involve combining or integration of qualitative and quantitative research data in a research study. Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes close-ended responses such as found on questionnaires. The intention was to capture the lived experiences of the study respondents using a qualitative approach. More so, the qualitative research design enabled the investigator to gather information from the insider's perspective. In this case, the qualitative research design enabled the researcher to have a full encounter with the respondents. This enabled for the description of how the respondents feel about sand mining.

4.5 Population and sample

Mentz Village was used to collect data about sand mining, land degradation and rehabilitation from the people who are taking part in the sand mining activities. The study included the targets such as entrepreneurs, households and the Chief. The questions focused on their knowledge of legislation and regulatory frameworks and their application, their capacity to enforce such legislation and the mechanism thereof. Regarding the Chief, the questions focused on his knowledge of the impact of sand mining activities towards land degradation; systems and mechanisms to regulate such activities as land rehabilitation, permitting of miners, and suppliers. The questions also focused on his role in protecting the natural resources and mechanisms thereof. With regard to community members as consumers of the mined sand, the questions focused on their knowledge of the impact of sand mining activities on the environment that can actually cause effects such as land degradation and how they can play a role in ensuring the balance between protecting the natural resources and better living.

4.5.1 Sample composition

Fifty (50) respondents were selected from the Mentz Village community to participate in the interviews. The sample was composed of the general members of the community, the Chief and the sand miners. Community members formed the whole composition because the researcher intended to get an insight into the community's views about sand mining; if sand mining affects them at all and what they feel should be done to rehabilitate the area. The researcher discussed with the Chief, in order to understand whether the Chief had consented to the work of the sand miners in the area. The last group consisted of the miners; the researcher sought to ascertain that they had permission to do their mining in the area; to establish if they were aware of the effects of sand mining; and if they had rehabilitation plans after conducting their work.

4.5.2 Sample size

All the respondents came from the Mentz Village community. A total population of 50 respondents aged between ages 25 and 50 were selected to participate in this study. The population was made up of 42 community members, one village Chief, six sand miners and one councillor.

Community members	Village Chiefs	Sand Miners	Councillors	Total sample
42	1	6	1	50

Table 1: Sample composition

4.5.3 Sampling procedure

Participants were concentrated in the Mentz community and they were selected through a combination of criterion purposive sampling and supplemental snowball sampling. Snowballing is a sampling method where initial informants are asked to give names of other potential informants. Snowball samples are probably the easiest way to build a pool of qualified informants in a highly specialised field (Creswell, 2003). The Researcher identified the gatekeepers using the criterion of purposive sampling. Filtering questions based on a guideline script (See attached appendices) was used to facilitate the screening process as well as to obtain commitment to the interviews. After the interviews, the respondents were asked to provide the names of other members of the Mentz community who are practising sand mining.

Although there was a need for about 80 respondents, however, interviews were conducted until the point when the investigator believed the study to be comprehensive, which were eight interviews from key participants and lastly the researcher distributed the forty-two questionnaires. Due to the unavailability of the respondents, the questionnaires was given to the identified initial respondent and the respondents would recommend other members based on their availability and this is how snowballing was utilised.

4.6 Data collection

Data were collected with an interview schedule and questionnaires.

4.6.1 In-depth interviews

According to Guba et al. (2011), an in-depth interview is a face-to-face interaction between an interviewer and the study respondent, which seeks to build the kind of intimacy that is common for mutual disclosure. In this study, all the respondents were

happy to participate in the interviews and they even called for feedback. The aim of the interview was to ascertain the perceptions of the respondents in order to produce qualitative data about sand mining and rehabilitation.

4.6.2 Interview procedure

Before conducting the interviews, the ethical clearance from the Turfloop Research Ethics Committee (TREC) at the University of Limpopo was granted, the letter from the Faculty of Management and Law and the village Chief allowing the conducting of the research in the area (See attached appendices). Upon arrival at the interview location, an introduction was done so that community members are made aware of who will conducting research. The researcher then read the project information to the informant and then presented the consent form to the informant to sign. After the form was signed, then questions were asked based on the interview guide while taking notes.

The interview schedule was developed to ask the same questions to all the respondents sampled for the first phase of data collection. Open-ended questions were put to the respondents. Throughout the research process, the respondents were asked for further explanations as new issues arose. The interview schedule was made up of four parts, it commenced with biographical information of the interviewees such as age, gender, educational level, and other social aspects. These were followed by open-ended questions, which focused mainly on informants' knowledge about sand mining. In the third phase, the respondents were asked questions on land degradation and the effects of sand mining. The fourth and last parts of the interview schedule consisted of questions relating to land rehabilitation and its significance on the environment.

Prior arrangements were made and interviews were subsequently conducted. The time allocated for each interview was about one hour. Interviews were conducted in the households of the respondents and some at their workplaces or places of their comfort; this is where they were most comfortable. Interviews were conducted in English and Sepedi and no conversations were held with the assistance of an interpreter. After each interview, the researcher thanked the informant and asked if he or she had any additional insights or thoughts. In addition, the researcher asked for

the names and, if available, the contact information for other respondents, as a way to further the snowball sampling method previously discussed.

4.6.3 Interviews with Chief, Councillor and Sand Miners

Interviews were conducted with eight respondents in their own households and the workplace. The interviews were conducted in the same pattern at the different locations the same interview schedule used to interview the Chief, Councillor and the sand miners.

4.6.4 Date and venue of data collection

Venue	Respondent	Interviews	Date
Mentz Ga-Shiloane	Chief	1	04 December 2017
Mentz Ga-Shiloane	Councillor	1	10 December 2017
Mentz Ga-Shiloane, Mshengovile, Matshelapata, Badimong Malesa and Segoreng	Sand miners	6	18 December 2017 - 07 January 2018

Table 2: Date and venue of data collection

4.6.5 Questionnaire distribution

Fifty (50) questionnaires were distributed, however, some were spoiled and others were not filled. However, the researcher managed to get 42 questionnaires required by the study, which were filled correctly, with the relevant information sought.

4.7 Data analysis

The two types of data analysis for this study were used and that is the SPSS and Nvivo software. For descriptive statistics, the study utilised the SPSS software and the following statistics were used to analyse data.

The qualitative data were analysed using Nvivo 10 software. The qualitative element included face-to-face interviews, which were carried out with the community members and the sand miners. The qualitative software often has tools that facilitate theory building from the data whilst the tools in NVivo 10 push the researcher to draw theory

from data. It is, therefore, not imperative to follow the grounded theory guidelines when using the NVivo 10 software.

4.8 Reliability and validity

According to Creswell (2003), reliability is the extent to which the observable or rather empirical measures that represent a theoretical concept are accurate and stable over the repeated observations. This is about all the instruments that were used in the study to ensure the reliability and validity of data. The reliability of the study was determined by the techniques used for data collection. The published and academically recognised sources were employed for the literature review. Reliability was also being ensured by the use of the different data collection techniques. The questionnaires, interview schedules, observation and photo graphics were used as well in the study to ensure reliability. However, validity is mostly concerned with just how accurately the observable measures actually represent the concept question or whether they represent something else. Fieldwork was also undertaken to collect primary data. The field survey was carried out using different techniques and field instruments, such as questionnaires and key-informant interview schedules. The questionnaires developed by the researcher were revised after a pilot study was conducted with three families who did not form part of the study.

4.9 Trustworthiness

The accuracy of the data was ensure, fabrications, fraudulent materials, omissions and contrivances were avoided. The accuracy of the information was ensured by reporting the results as accurate as possible. The researcher made use of verbatim accounts of the respondents in order to show the truthfulness of the study findings. The supervisor was also responsible for examining the data, findings, interpretations and recommendations in order to attest that they are supported by the data.

4.10 Ethical considerations

The researcher had a moral obligation to strictly consider the rights of the participants who were expected to provide the information. The researcher abided by this principle by ensuring the following key aspects.

4.10.1 Informed consent

Consent involves the procedure by which an individual may choose whether to participate in a study. The research procedure included several steps to protect the rights of informants. Before the interviews began, the researcher read a script that explained the purpose of the study, that participation was voluntary, and that there were no known risks of participation. Each respondent was then given an informed consent form and project information in-person before the interviews started. The form began by stating that participation was voluntary, the respondent could skip any question he or she would rather not answer, that the interview could be stopped at any time. The consent form explained the rights of the informant whereas the project information explained the goals of the research and what to expect in the interviews.

The respondents were given the option of having their names to remain confidential on the informed consent form. All respondents willingly gave permission for their age, educational statuses and other personal information to be stated in this study. All interviewees granted permission to use a tape recorder and all the respondents consented to participate in the study.

4.10.2 Confidentiality and anonymity

Anonymity and confidentiality are two ethical standards applied to protect the privacy of the respondents. The researcher assured the respondents of anonymity and confidentiality. The issue of anonymity was addressed by making sure that no name of the respondent appeared in the final report. On the other hand, confidentiality was guaranteed when the researcher could identify a given person's responses but promised not to divulge the information to anyone but only for academic purposes. The information that was given was used for the purpose of the research.

4.10.3 Right to Self-Determination

The right to self-determination is based on respect for persons and indicates that people are capable of controlling their own destiny. The respondents should be treated as autonomous agents, who have the freedom to conduct their lives as they choose without external control (Burns & Grove, 1999). In the entire process of this research, the respondents were informed that the research is entirely voluntary and they could

withdraw from the research whenever they felt they needed to. However, none of the respondents in this research opted out as all of them participated to the end.

4.11 Summary and Conclusion

In this chapter, a presentation of the research design and methodology was employed to conduct this study. The sampling and sampling techniques that were used in the study were outlined. The structures of the data collection instruments were presented. In addition, the strategies that were used to ensure the validity and reliability of the study were presented in detail. Lastly, the researcher outlined the methods that were used to ensure that data is collected, analysed and reported ethically. In chapter five, more clarity is given based on the data presentation, analysis and interpretation of the study.

CHAPTER FIVE

DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF THE STUDY

5.1 Introduction

The mining of sand has become common practice in both developed and developing countries. There is physical impact, which is as a result of mining from streambed causing alteration of channel slope and changes in channel morphology. Sand mining causes water quality impact and dredging activities, reducing water quality for downstream users and increase treatment costs. For thousands of years, sand and gravel have been used in the construction of roads and buildings. Mining operators, in conjunction with acquainted resource agencies, must work to ensure that sand mining is conducted responsibly. These activities have economic and social benefits, but sand mining can also have detrimental effects on local ecology, stability, and other socio-economic activities. This chapter discusses the results and findings of research on sand mining, land degradation and the significance of rehabilitation in Mentz Village. Data were collected through individual interviews and a questionnaire survey. Interviews were conducted on people who are directly and indirectly involved in sand mining.

5.2 Demographic data of the respondents

Respondents in this study were both males and females. The study aimed at interviewing both the males and females in Mentz Village who were interested in taking part. The demographic information is discussed below.

5.2.1 Age group

Statistics		
Age Group		
N	Valid	42
	Missing	0
Mean		2.4286

Std. Error of Mean	.15670
Std. Deviation	1.01556
Variance	1.031
Skewness	.204
Std. Error of Skewness	.365
Sum	102.00

Table 3: Age Group Sample Information

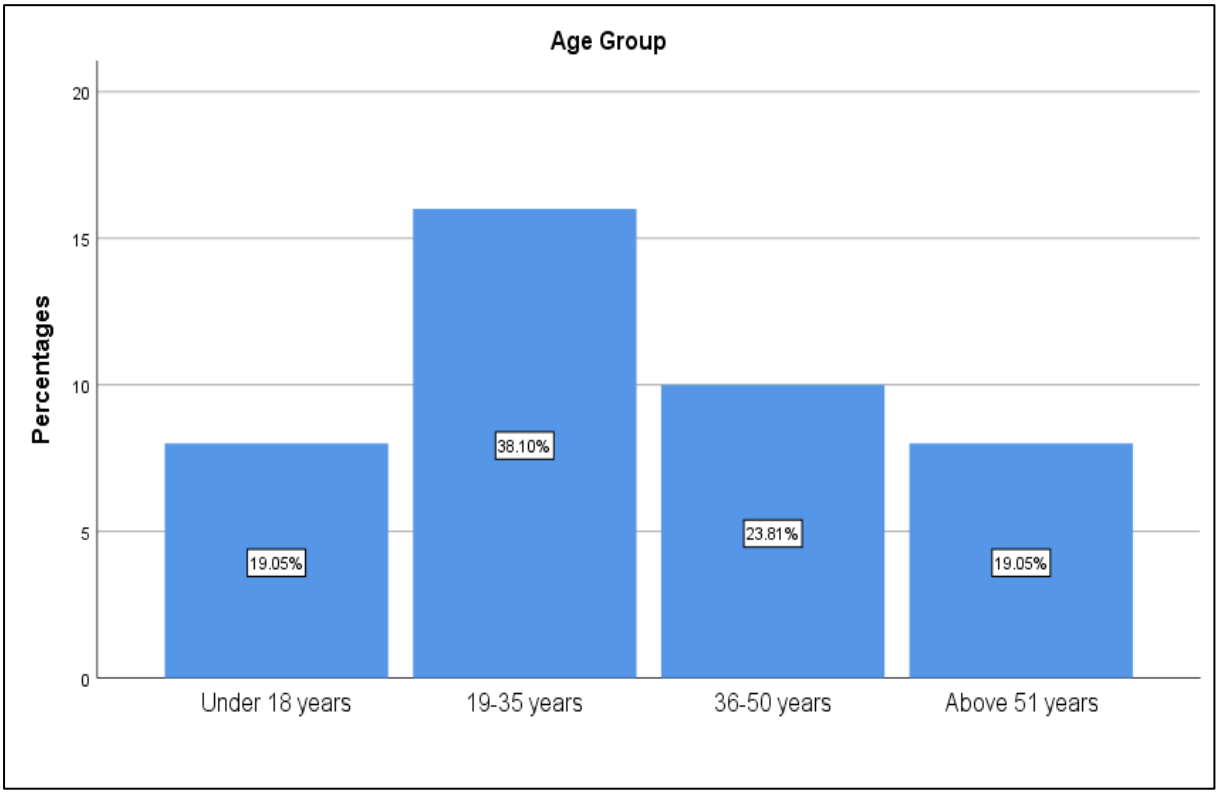

Figure 1: Age group sample in Mentz Village

The figure above illustrates the age group of the sample that was surveyed using questionnaires. The results above indicate that the majority of the people were between the age of 19 to 35 years with 38.10% and the second-highest was between the age of 36 to 50 years with 23.81%. The remaining two age groups have the same percentages, which is very rare to find in rural communities. In Mentz Village, people who are above 51 years and people who are under 18 share the same percentage. In the study, it was found that the two age groups had 19.05% and if the sample size was large enough, the sampling distribution was considered normal. However, even though

the sample size of this study was not large enough, it can be considered as normally distributed when looking at the table above. This is because sampling distribution can be determined by two values, the mean and the standard deviation.

5.2.2 The gender group of Mentz Village

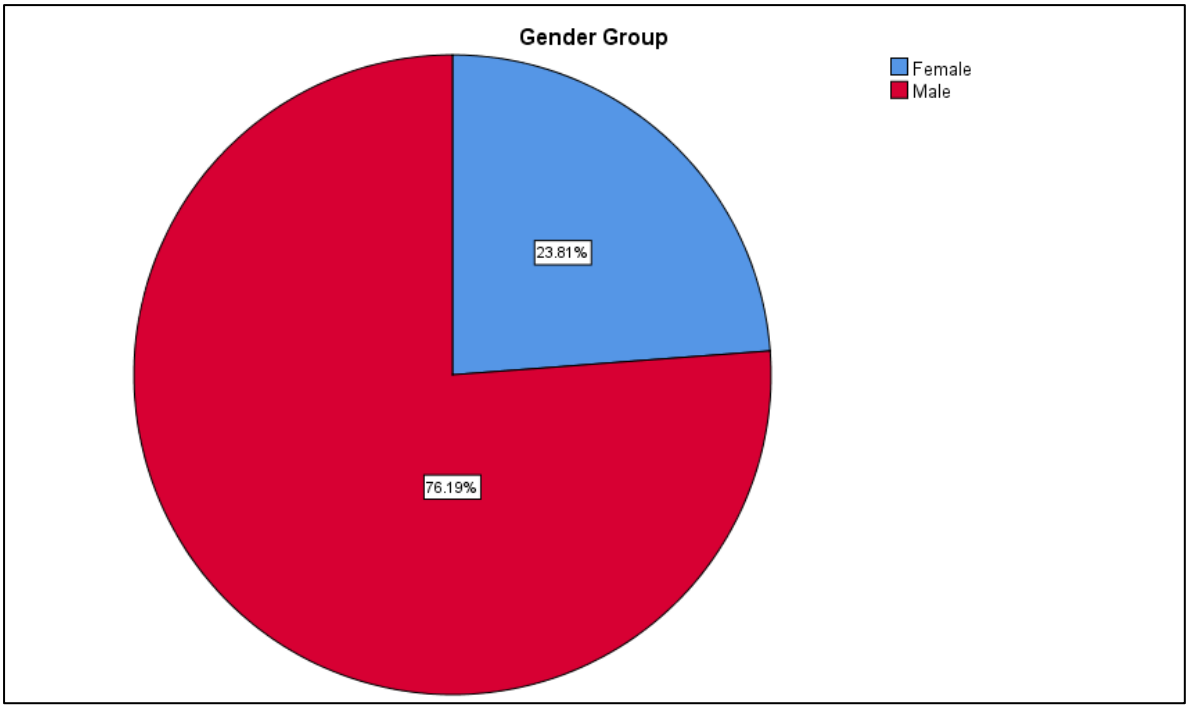

Figure 2: Gender group of Mentz Village

Figure 2 shows males and females that were considered for data analysis. The study administered 50 questionnaires but only 42 respondents were considered for the analysis of results because eight (8) questionnaires were discarded since they were incomplete. In an industry that is dominated by men, it was no surprise to get the many men that are actively involved in sand mining as compared to females. For this study, more males were interested in taking part in the research because sand mining is a male-dominated activity. Madyise (2013) supports that very few women are involved in sand mining activity and hardly ever visit the areas so they are not aware of what exactly happens at mining sites.

5.2.3 The population group of Mentz

Figure 2. Shows the racial makeup of the Mentz Village. The study found that the majority of the community members were black Africans. The analysis illustrated that 97.62 % are black Africans and the remaining 2.38% are coloured but results show

that there was an increase in the coloured category in the census (Statistics SA, 2011). The 2011 census showed that the racial makeup of Mentz Village was 99.08% of black Africans and 0.1% were coloured Africans.

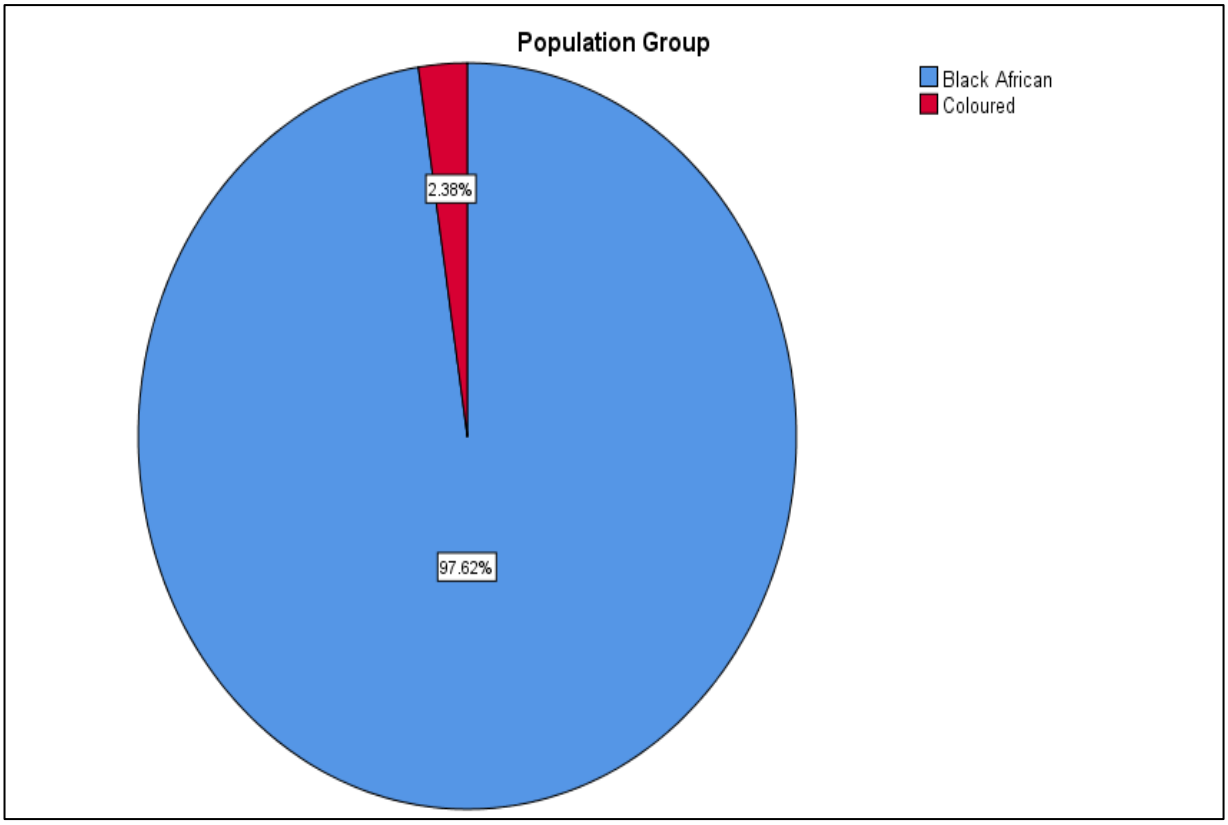

Figure 3: Population group of Mentz Village

5.2.4 The educational status in Mentz

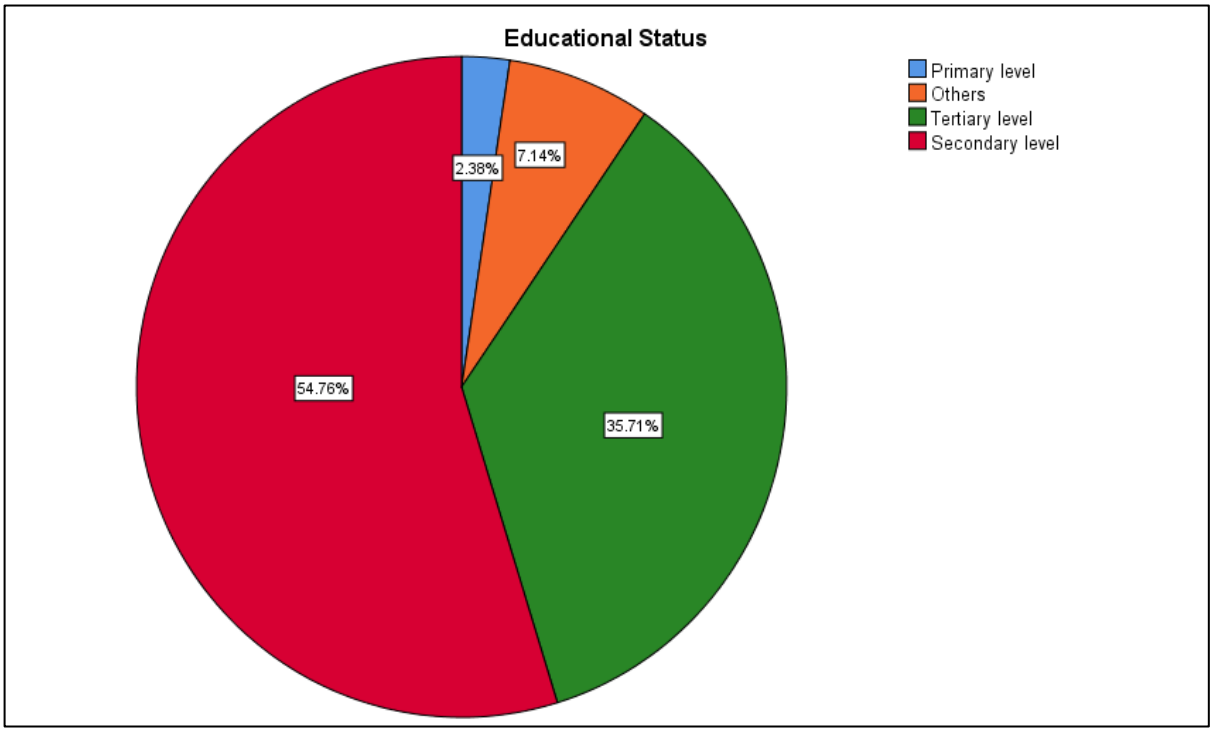

Figure 4: Educational status in Mentz Village

Figure 4 illustrates the education status of Mentz village, whereby a sample size of 42 people was asked to take part in a questionnaire, using a purposive sampling method. The majority of the people had a secondary education with a percentage of 54.76% out of the 42 people and the second highest was people with tertiary 35.71% education. Those without formal education were classified as other with 7.14% and 2.38% had primary education. A general conclusion can be drawn based on these results that the Mentz Village is comprised of people who are educated. Education influences decisions regarding land use and land management. A person's decision can result from many factors, including incentives, access to capital and risk management, but also from knowledge and level of education, all of which may affect land use and management practices. Land use and management are dependent on the total of all decisions taken by individuals of different education and gender groups in a community, hence it was important to collect data on the educational status and gender of the Mentz Village population prior to collecting the actual data.

5.2.5 The Employment status of Mentz Village

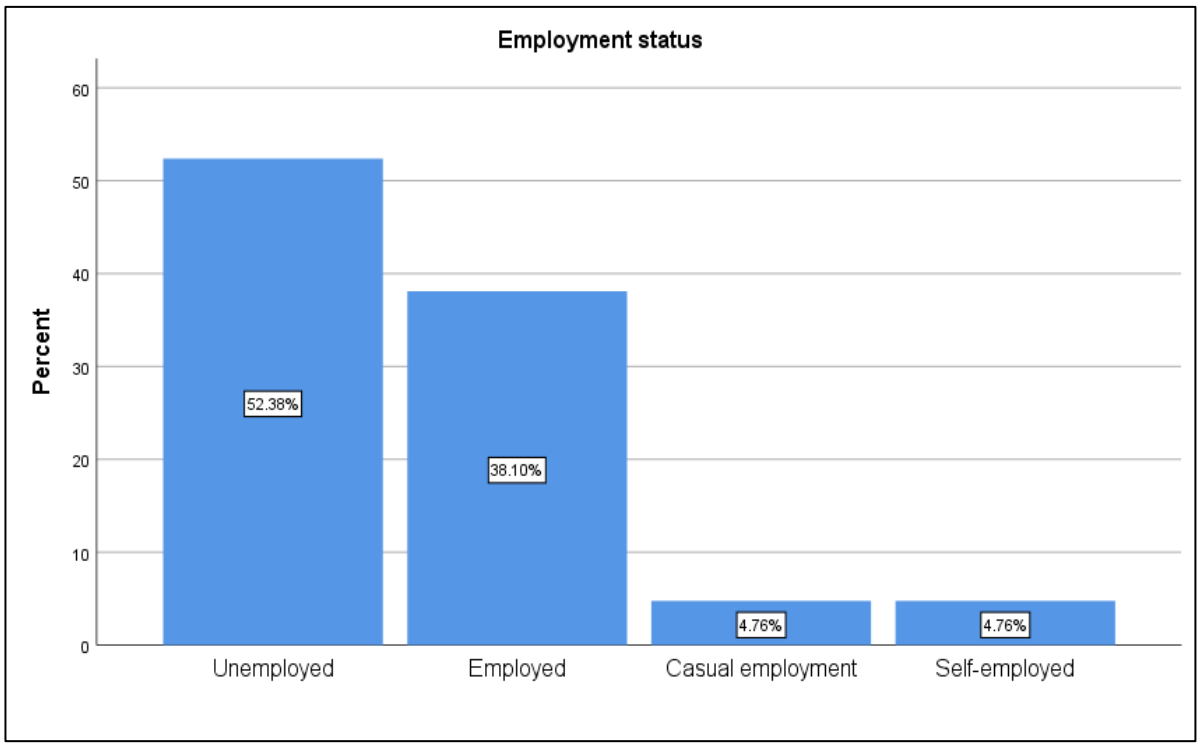

Figure 5: Employment status of the community members in Mentz Village

Figure 5 shows the employment status of the participants of Mentz that the majority of the people in the village are unemployed at 52.38%. Only 38.10% of the surveyed people are employed while 4.76% are casually employed and the remaining 4.76% are self-employed. Martinez and Fernandez (2010) supposition that when one is educated, there is a greater chance of being employed support the above results. Thus, there is a linkage between literacy and employment. Martinez and Fernandez (2010) made an example of three countries Ecuador, the Dominican Republic and São Paulo where the linkage was very high between illiteracy and high unemployment rate. The socio-economic impact of sand mining is made by profitability in the face of chronic unemployment. The former is a reflection of high price parity between the loading fee and the selling fee together with the non-payment of taxes. Population growth also plays a significant role by contributing to the lack of jobs. On the other hand, Mattamana et al., (2013) contend that sand mining has become an industry giving job opportunities for thousands of people. However, it also provides direct employment.

5.3 The nature of sand mining

5.3.1 The participation in Sand Mining Activities in Mentz Village

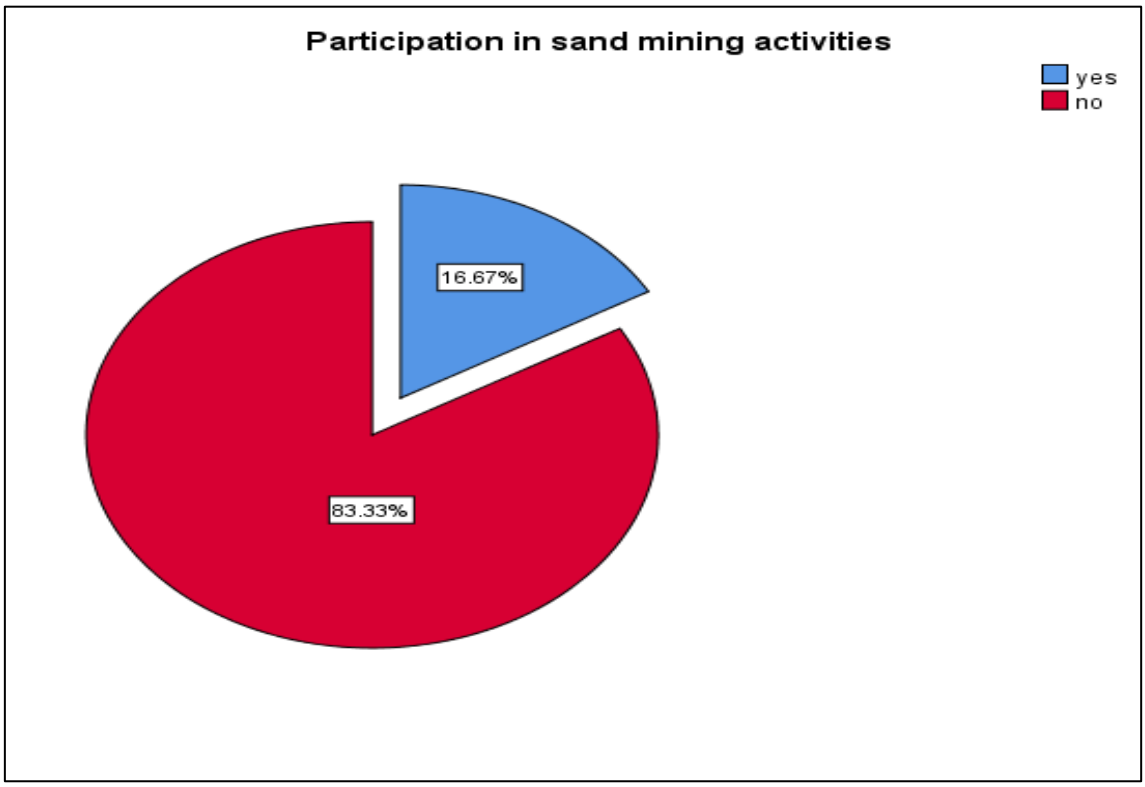

Figure 6: Participation in sand mining activities

Figure 6 shows the participation in sand mining activities in Mentz Village. The participants were asked if they participate in the sand mining activities that are taking place in the area and the results are as follows: 83.33% responded that they do not participate in the activity, while 16.67% of the participants responded that they participate in sand mining activity. Out of this, 16.67% that agreed that they do take part in sand mining were males and the results just proved or illustrated that it is the males who are actively involved in the sand mining activity, while the remaining 3.97% of females are involved. The results are in line with Madyise (2013) when they state that the sand mining sector is male-dominated even though women try to enter the sector. Approximately 30% of the world's sand miners are women who occupy a number of roles ranging from labour-intensive mining methods to the processing aspect of sand mining. In most instances, females' roles differ from those of males in the sand mining sector; essentially the role of men extends well beyond direct participation in sand mining activities.

At a community level, mining operations can cause environmental degradation, which increases the time it takes to collect water, prepare food, and carry out small-scale farming, all tasks conventionally undertaken by women. Despite the clear need to engage women in decisions around the sector, they are often left out of community consultation, compensation discussions and processes. When women are excluded from community consultations, they are less likely to know about grievance procedures when negatively impacted by extractive operations. This is not necessarily in all cases because when looking at a study that was done in Malawi where women tend to be more involved in sand mining, which contradicts the findings from this study. When compared to other sectors in the country (Malawi), the sand mining sector has a significant concentration of women and there are ongoing efforts to support their participation. A 2002 study placed the number of women working directly in sand mining at approximately 4,000 accounting for 10% of the sector.

5.3.2 The feeling about sand mining extraction in Mentz

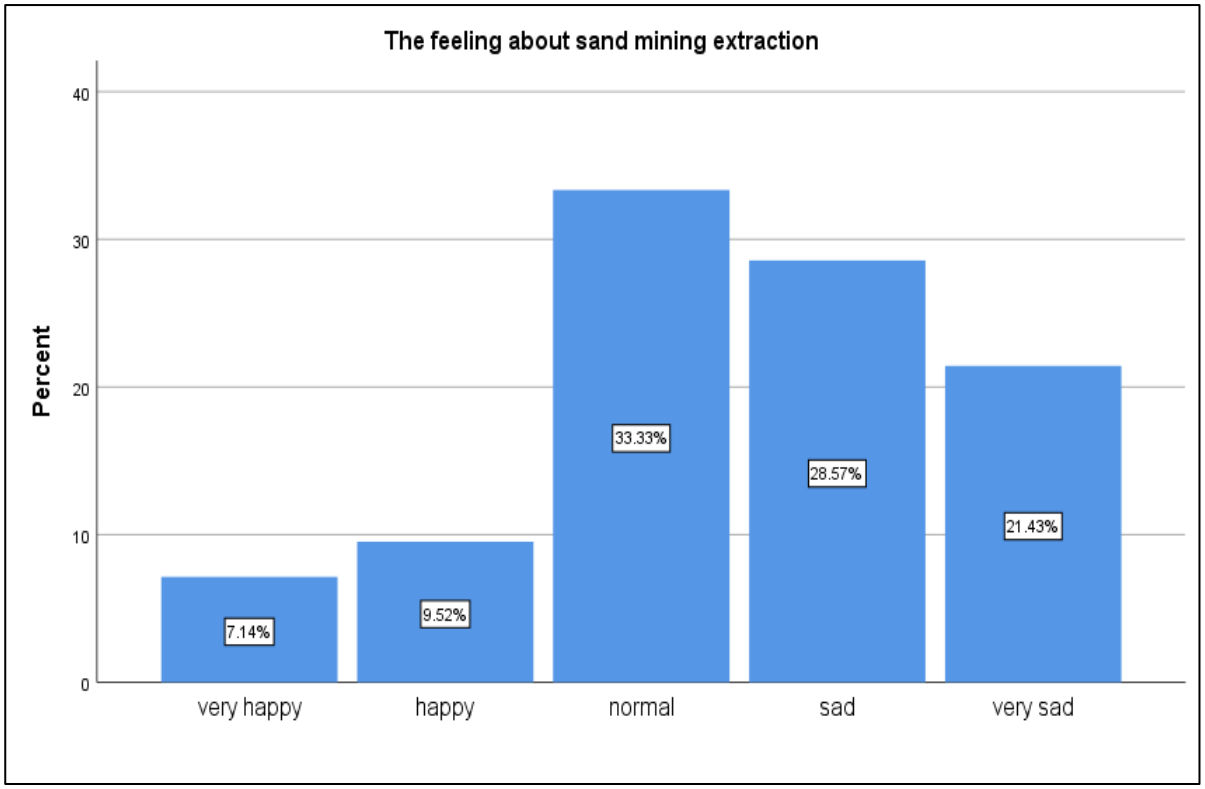

Figure 7: Sand mining extraction

Figure 6 above indicates the results from the respondents in Mentz Village to get their perspective towards the sand mining activities taking place around their community.

The respondents were asked how do they feel about sand mining extraction and the majority of the respondents (33.33%) supported the idea of having sand mining operations because people make a profit out of these operations and this reduces unemployment in the area. Half (50%) of the respondents expressed great sadness concerning the sand mining that is taking place around their community, given the land degradation and soil erosion that takes place immediately after sand miners have invaded the place. This 50% was split into two, one with 28.57% and 21.43% whereby they were categorized from sad to very sad, respectively. Only a handful (16.66%) were happy about the sand mining taking place in the area.

The majority of the population indicated that sand mining was regarded as a poverty reduction strategy in the area by sand miners and a socio-economic way to sustain themselves as these sand miners sell the sand to some of the community members for infrastructural purposes. The 16.66% was divided into two with 7.14% and 9.52% whereby they were categorized from very happy to happy, respectively. It is safe to assume that those who were happy (16.66%) that did not see the sand mining as a problem were aligned with the 16.67% of the respondents that agreed to have been actively involved in sand mining. Dacosta and Mathada (2017) state that in the study conducted in Nzhelele River in Limpopo Province where the results show that the majority of people see sand mining as an economic benefit. The image below shows the sand mining that is taking place at Mentz Village:

Image 1: Sand mining truck at Mentz sand mining location

Source: Photos taken during the fieldwork

5.3.3 The effects of sand mining on the residents of Mentz

Sand mining activities have various effects on the environment and these challenges affect the residents as well whereby the open pits are left unattended and they become breeding places for mosquitos.

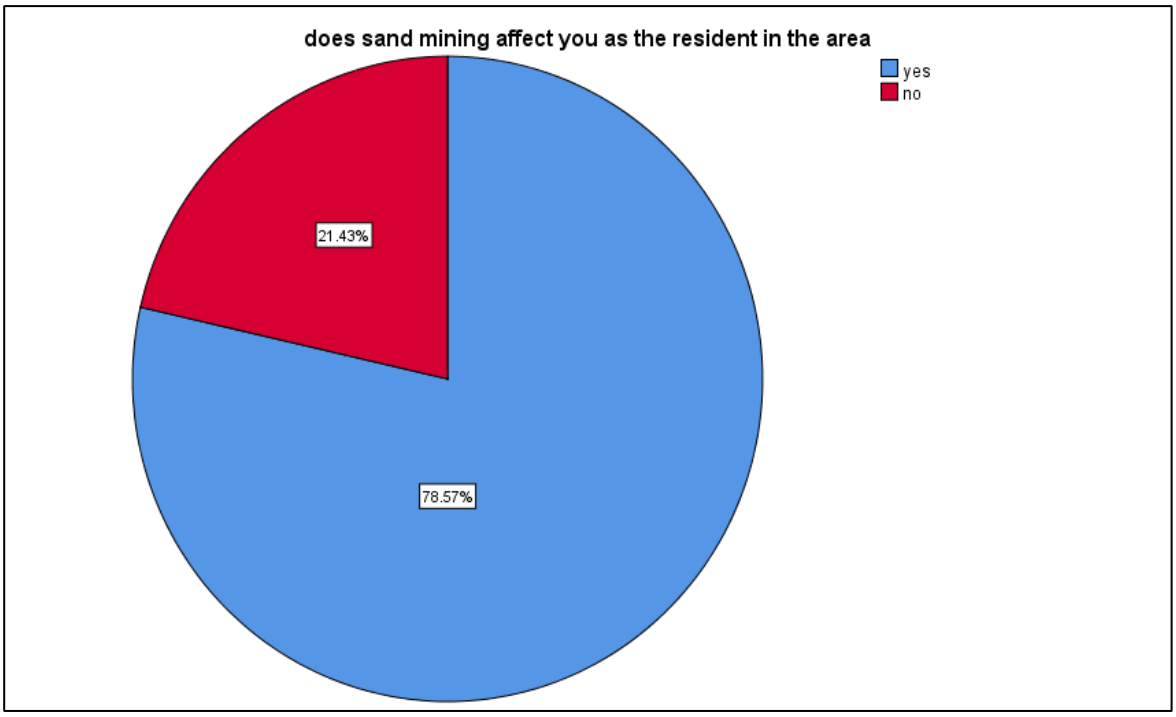

Figure 8: The effects of sand mining activities on the residents

Figure 8 Illustrate the results of the respondents' answers to the question asked to them. An overwhelming majority of 78.57% responded with a "yes" that they were being affected by the sand mining activities and the remaining 21.43% responded with a "no" that they are not affected by the sand mining activities in the area. The reason why the majority of the respondents responded that they were affected by sand mining activities is that there is no designated or specific area where sand is extracted, therefore, often at times, some of the sand mining activities are done illegally or in areas that are not suitable for sand mining.

For example, the sand miners can mine the sand next to someone's yard because they saw a potential area where sand is easily accessed. Others are being affected because these sand vehicles pass next to their yard after sand mining and this causes noise pollution and a lot of dust. One of the respondents stated that this is disturbing because they leave their windows always open for fresh air purposes and always find

their furniture with dirt from the sand. Also during rainy seasons, too much runoff ends up threatening the surrounding residential areas. Further, the areas dug became breeding grounds for mosquitos. During the interview with some of the miners, they indicated that the closer the site is to the market the more profit they make as they save on transportation costs. The nature and magnitude of the impact depend on the physical characteristics of the location, the technology used for extraction and the size of the operation.

Kondolf, (1997), also observed this kind of scenario, just like Dacosta, and Mathada, (2017) in a study on the effects of gravel mining on dams and river systems. Khan and Sugie, (2015) state that in a study conducted in rural Bangladesh, the impact of sand mining on society has a great deal on farmlands as they get washed away. They also mention that 29 households have transferred their main houses from/within Haji-para for erosion. Dacosta and Mathada, (2017) conducted research on the Nzhelele River where illegal sand mining was taking place to assess the social impact of this activity. The study uncovered that the illegal sand mining activities conducted along the Nzhelele River pose a threat to bridges, river banks and nearby structures. It is safe to state that sand mining has dangerous repercussion to the general society, therefore, this activity should be practised with caution at all times to try to mitigate some of these problems.

The image below shows some of the disturbances that the community go through because of sand mining activities.

Image 2: Sand mining activities at Mentz Village

Source: Images obtained during the fieldwork

The image was taken by one neighbour at Mentz Village during the questionnaire interview as proof of what they go through and what kind of impact they experience as a community. For example, a window is wide open and trucks pass by the households and the likelihood of wind carrying some of the soil particles to the house are high. The participants also complained about the noise that the trucks make that is unbearable.

Source: Images obtained during the fieldwork

During the interview, one participant mentioned one interesting factor that sometimes when children (infants) are sleeping, they wake up because of the noise that these trucks make when passing their houses. These results are in line with the findings that were reported by Musah, (2009) that sand mining causes conflicts including noise, dust, truck traffic, pollution and visually unpleasant landscapes. Also, Madyise, (2013) observe a similar problem that was observed in this study, which means there is continuous noise generated by these machines which hampers sleep for residents living near extraction sites and gravel roads. Too much noise and impact cause cracks on nearby houses and buildings as was revealed by residents.

5.3.4 Accidents reported during sand mining

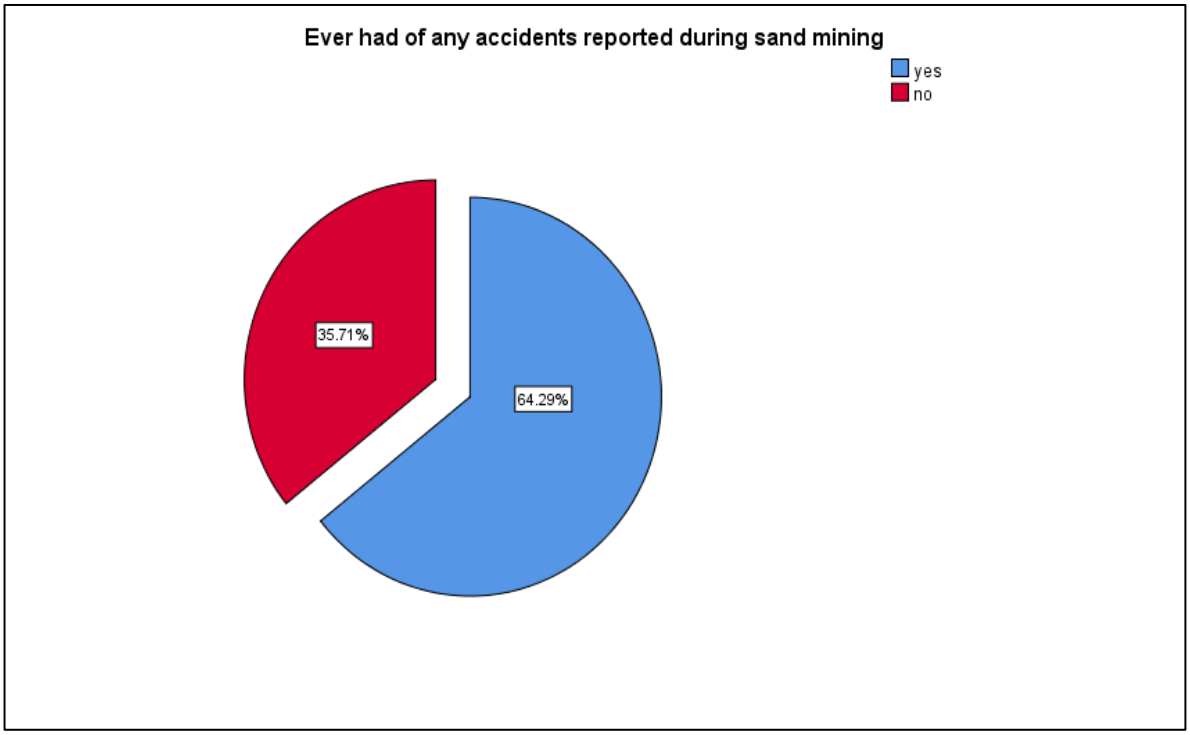

Figure 9: Accidents reported during sand mining

Figure 9 indicate the respondents' response to the question if they have ever heard of any accidents reported during sand mining? As one could have expected that getting in sand mining is a risky business and often sand miners use techniques that are manual to dredging or digging which may expose the workers to multiple work-related disorders or cuts (Mohapatra et al., 2017). Respondents indicated that they have heard of accidents that happen in sand mining and 64.29% responded "yes" while 35.71% responded "no" that they have not heard of anything. The common accidents are musculoskeletal injuries and the most frequently occurring is cuts. The musculoskeletal injuries are neck pains and back pains just to name a few.

5.4 The nature of land degradation

This is about understanding of the concept of land degradation. The focus was on getting to know if whether the people in the area understand what land degradation is all about.

5.4.1 The understanding of land degradation

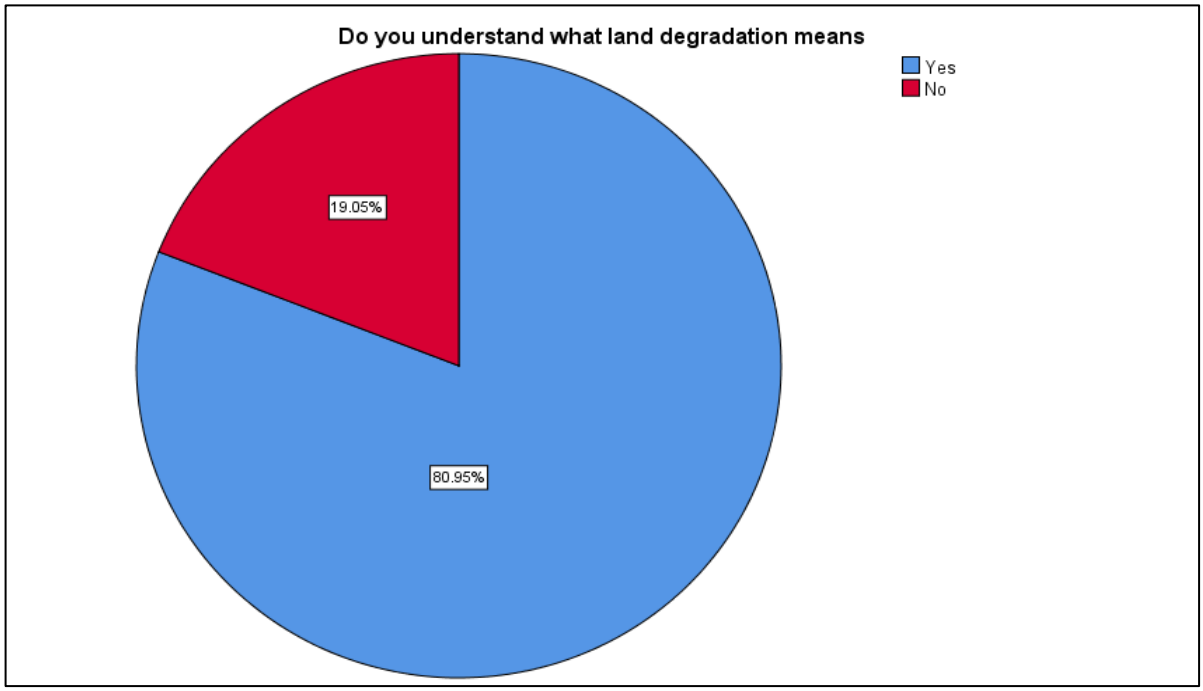

Figure 10: Land degradation understanding

Figure 10 Illustrates the respondents' responses to the question that was asked about whether they understand, what land degradation is. The finding shows that the majority stated that they understand what land degradation means, which amounts to 80.95% and while the remaining 19.05% stated that they do not understand what land degradation means. The question was in their language so that they can easily understand what the question is all about. The majority of the respondents understood what land degradation is, and were then asked a follow-up question to explain what do they understand about land degradation. Those who responded with "yes" that they understood land degradation mentioned various issues that emerge because of sand mining, the issues range from; flooding, soil erosion, runoff and dumping sites. The participants then went into details by elaborating on each issue, for example, dumping site "the pit or hole that have been left by the sand miners becomes a dumping site

that is used by the community members at the end of the day we end up with more dumping sites all around". With regard to soil erosion, the respondents mentioned that the sand miners often at times clear vegetation around where they mine the sand, therefore, during windy days there is soil erosion taking place. The soil erosion is supported by the critical statistics that more than 0.7 million hectares (ha) of land is degraded by soil erosion and 0.19 million has degraded by waste rock dumps, and mining (State of the Environment South Africa, 2008). Communities were closer to the source of the river host both instream and floodplain mining. Field studies confirmed that floodplain sand extraction activities are causing a severe impact on agricultural lands and the vegetation on the floodplains.

Furthermore, flooding and runoff were used interchangeably by different respondents but the concept remained the same, they all stated that when the rains come, there is too much water that is flowing through the mining areas and washing the top fertile soil as the water navigates through the village. In addition, some of the sand that is washed by rain get piled up at one place normally downslope. This is well supported by Dlamini et al., (2014), where they state that land degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the environment. Africa has significant sand mining in the Republic of South Africa and Sierra Leone in West Africa. The image below illustrates the impact that sand mining activities have on the environment during rainy seasons:

Image 4: Sand mining area and land degradation

Source: Images obtained during the fieldwork

Land degradation is a significant issue in South Africa with 60% of the land currently degraded (UNEP, 1997) and approximately 91% of South Africa potentially vulnerable to desertification (Hoffman & Ashwell, 2001). Also, the issues that were raised by the respondents in this study were issues that other studies or research picked up during their investigation, researchers such as Ako et al., (2014) looking at north-west Nigeria; Saviour (2012) looking at India, whereas Syah and Hartuti (2018) looked at Indonesia. It is viewed as any change or disturbance to the land that can be perceived to be undesirable. Those who did not understand what land degradation means, this may be because they had less education or no education at all and when referring to figure 4 (education status), such people can be categorized as people with no formal education and only primary education which constituted 9.52% in total. The mined areas have been abandoned with little or no reclamation effort.

5.4.2 Land degradation occurrences around Mentz Village

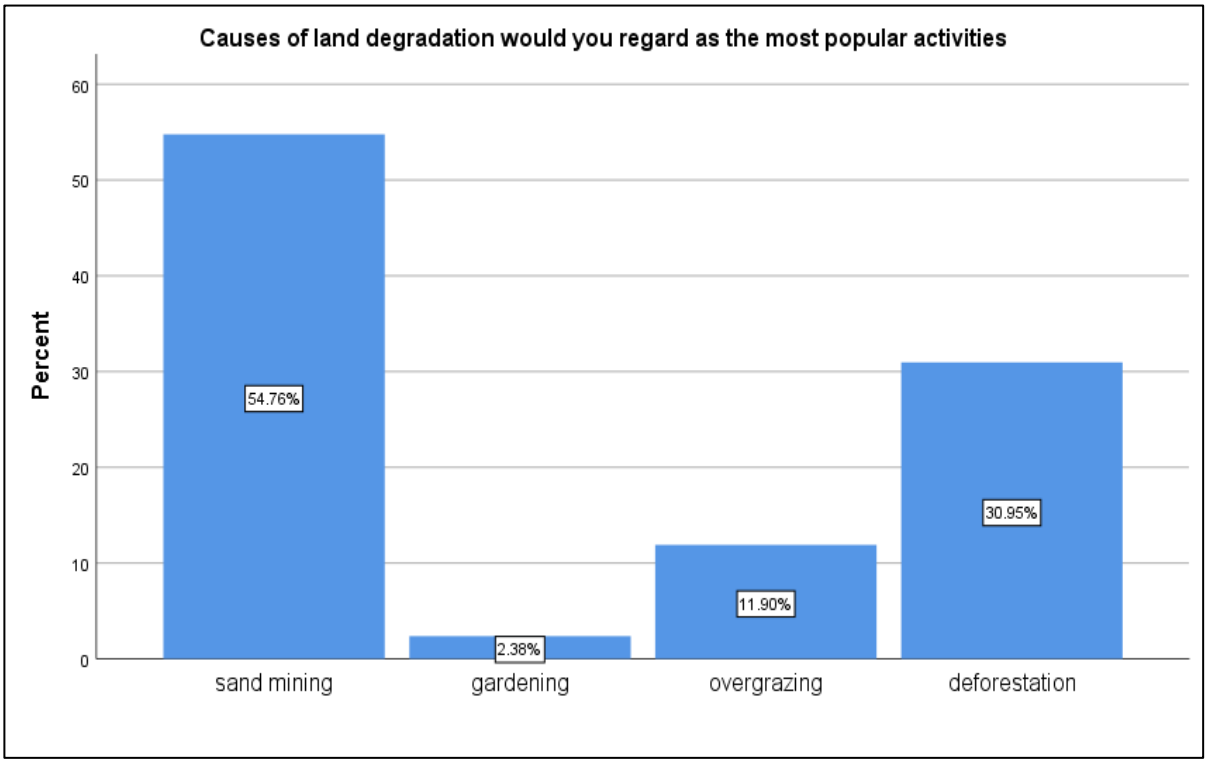

Figure 11: Causes of land degradation around Mentz Village

The above graph illustrates the respondents' responses to the question regarding the most popular causes of land degradation. The results show that 54.76% out of the 42 respondents stated that sand mining is one of the most popular causes of land degradation while 30.95% of the respondents stated that deforestation is the main cause of land degradation. A study conducted by the Food and Agriculture Organization (FAO, 2011) in Zimbabwe found that an estimated 24 billion tonnes of fertile soil is lost every year and this was due to main sand mining that was taking place in urban, semi-urban and rural services centres as well as growth point mainly due to construction activities. Therefore, this resulted in land degradation of the environment in Zimbabwe and the study concluded by saying that, as there is an ever-increasing rate of development in developing countries, so do the demand for sand for construction. This study supports the findings from this study in Mentz Village, sand mining is the main driver of land degradation. The image below also illustrates the impact that sand mining has on the environment and how these activities lead to land degradation because there is cutting of trees so that sand miners will be able to mine sand and make a profit.

Image 5: An example of where sand is extracted

Source: Images obtained during the fieldwork

At least 11.90% stated that overgrazing is one of the causes of land degradation and the other 2.38% is for gardening whereby respondents stated that it is also one of the causes of land degradation. According to the results, sand mining constitutes a higher percentage when it comes to the causes of land degradation. Madyise (2013) supports this where it is discussed in a study about environmental impact where the study found that sand mining is one of the biggest causes of land degradation. The pits are left uncovered, the pits end up being a breeding place for mosquitos, the mine pits become a dumping site after the sand mining process, easily flooded, and also sand gets washed to other people's yards. Studies by (Platts & Susan,1981; Nyandwi & Msuya,1997) observe that sand mining activities have a synergistic effect on land erosion and contribute to vegetation destruction (deforestation) and calls for the management of the mining process.

Image 6: Illustration of the effects caused by sand mining activities

Source: Images obtained during the fieldwork

Deforestation is a global problem as compared to sand mining whereby developing countries are battling the issue. Deforestation is considered a global threat and is treated in the same way as global warming. This is not a surprise to find that

deforestation was the second-highest cause of land degradation in Mentz Village because even the Statistics South Africa on land degradation reveal the same results. Deforestation for land clearing or resource extraction also contributes to land degradation in several districts of Limpopo, KwaZulu-Natal, and the Eastern Cape (SESA, 2009).

Livestock wealth plays a crucial role in the rural life of our country and very often one finds that the livestock grazing on a particular piece of grassland or pasture surpasses the carrying capacity and this is the case in Mentz Village when looking at the percentage (11.90%). The acts of compaction and erosion as a result of overgrazing can cause tremendous land degradation. In drier areas like Mentz Village, the experience is even worse as a large percentage of pasture and land cover is destroyed, contributing to the relentless progression of desertification.

Some of the respondents mentioned that the livestock trampling on the soil make the area to be dusty and when looking at their responses, one recalls how the land degradation process occurs. For example, due to trampling by cattle, the soil loses infiltration capacity, which reduces percolation of water into the soil and as a result of this, more water gets lost from the ecosystem along with surface runoff.

The results showed that 2.38% of the Mentz Village respondents believe that gardening is the cause of land degradation, and the result is in line with the literature because this was dealing with people who do backyard gardening and only a few have a big plot of land. Therefore, there is not much intensive farming going on in the area. This can be inappropriate farming methods for the type of land or soil forcing the land to produce food crops year after year without letting it ‘rest’ to build up the nutrients again.

5.5 The causes of sand mining on land degradation

The discussion was on the causes of land degradation and the activities practiced that led to land degradation.

5.5.1 The frequency at which people visit the sand mining areas

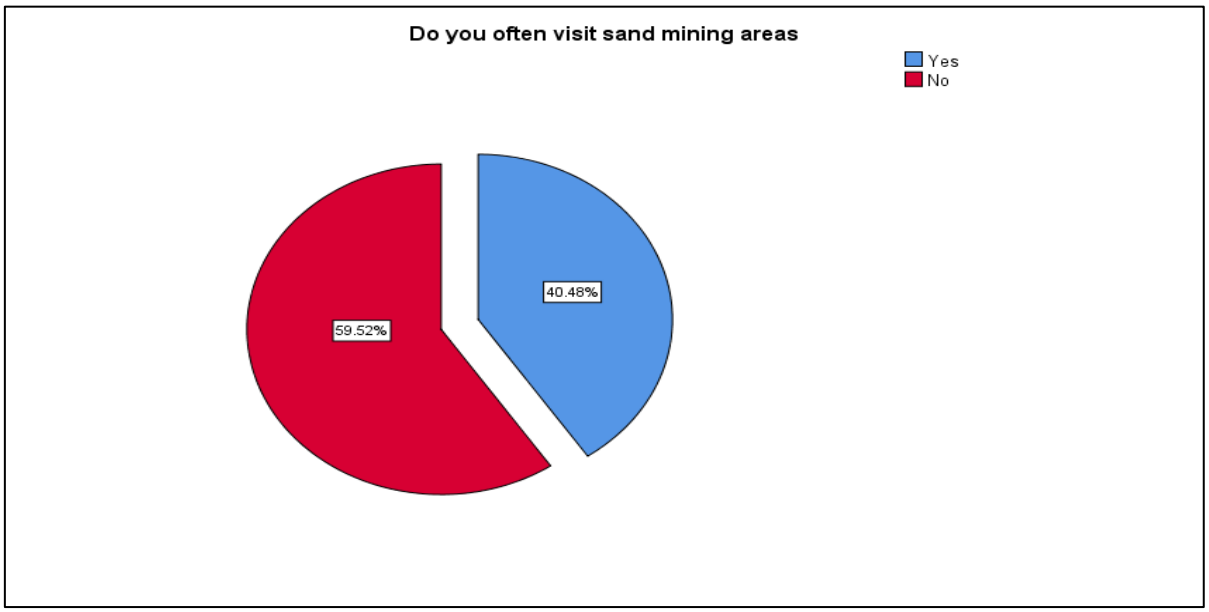

Figure 12: The frequency at which people visit the sand mining areas

Figure 12 illustrates the respondents' responses to the question regarding how often they visit the sand mining areas. The results show that 59.52% of the 42 respondents stated that they hardly visit the sand mining areas while 40.48% of the respondents stated that they do visit the sand mining areas. The respondents who visit the sand mining areas do various activities in the sand mining areas. Some stated that they visit the sand mining areas to get water since there are communal water tanks nearby the sand mining areas.

Some indicated that they go there so that they can access sand for infrastructural purposes. Since it is a well-known fact that most of the rural areas are developing and sand is needed for infrastructural development. Some of the respondents visit the sand mining areas to fetch wood for their households. Only a few mentioned that they go there to dump waste since other people have commenced the dumping of waste.

5.5.2 The activities that happen near sand mining

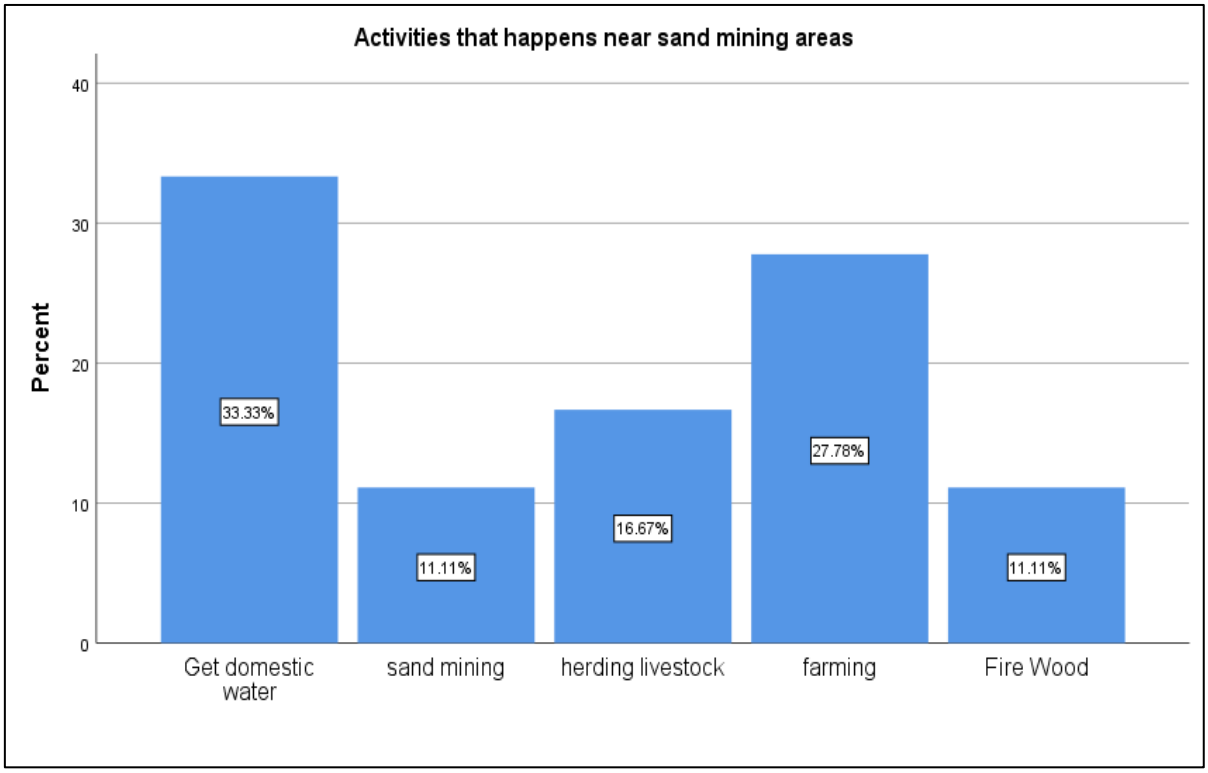

Figure 13: Activities that occurs near sand mining areas

The above graph illustrates the respondent's responses to the question about what activities happen near sand mining areas. The majority of the respondents stated that they get access to water near the sand mining areas since there are communal tanks where the community members can easily have access to water and this constituted 33.33% of the respondents. Other respondents also stated that they do farming activities near the sand mining areas and the percentage of these respondents was 27.78% of the 42 people who took part in the study.

Looking at the 16.67% of the total number of respondents that stated that they visit the sand mining areas for herding livestock or grazing pasture, one would have expected that this is the second or the first highest but not, in this case, and 11.11% of the respondents stated that there is more sand mining close to each other so there is not much happening in terms of other activities. While the remaining 11.11% of the

respondents stated that they visit sand mining areas to fetch firewood, as some of the households still depend on firewood for cooking and other purposes.

Moreover, the data presented above show that the residents in Mentz Village have other activities that are taking place near the sand mining areas. The main activities taking places around or near the sand mining areas as indicated by the respondents are herding livestock, farming and fetching water. Sand mining has a negative impact on the various activities that occur near the mining site. It involves the cutting of trees which hinders the opportunity for people to have easy access to firewood when there is dust which also affects the water that people must drink in the community. According to Madyise (2013) in a study conducted about the impact of sand mining and sand extraction, local police officers patrol mining areas during the day and at night to arrest and confiscate sand from illegal miners and this is done with help from neighbouring farmers who formed watch groups to guard the extraction sites near their fields.

5.6 The significance of rehabilitation in sand mining

The guidelines are important because they regulate sand mining activities and avoid environmental impacts.

5.6.1 The guidelines and laws that govern the sand mining activities

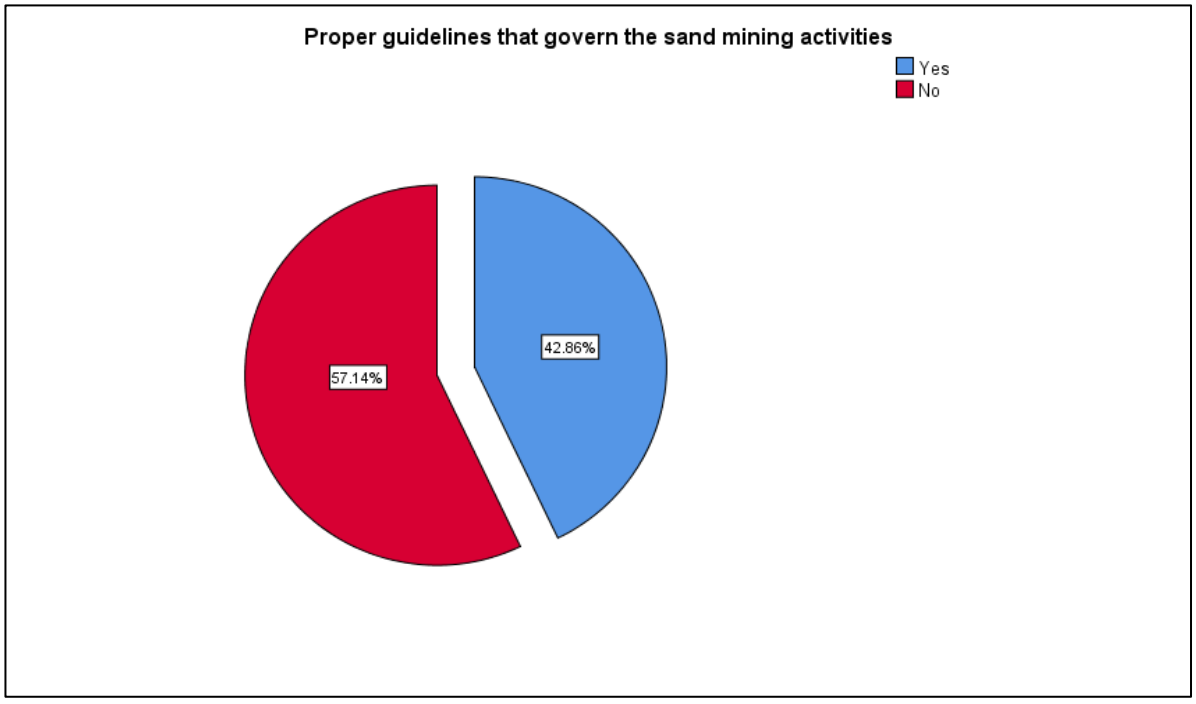

Figure 14: The guidelines and laws that govern the sand mining activities

The figure above indicates the respondents' responses to the question regarding the laws and guidelines that govern sand mining activities. Sand mining in South Africa is controlled by a complex regulatory system that can be categorized into three main themes: mineral regulation; environmental regulation; and land use planning regulation. A tremendous number of the respondents replied "no" that they do not know any laws or guidelines governing sand mining and this was 57.14% of the 42 people. While 42.86% stated that they are aware of the laws and guidelines that govern sand mining activities. The 42.86% of the respondents who knew what guides sand mining are mostly the people who practice sand mining activities and also this can be associated with the level of knowledge.

The respondents that replied with "yes" during the in-depth interview highlighted that they are aware that sand mining is now subject to mineral and land use planning regulation. Although there are laws and guidelines to govern the sand mining activities to try to keep sand mining under control, however, there has recently been a drastic increase in uncontrolled and unauthorized sand mining activities in rivers, valleys and estuaries throughout the country (Chevallier, 2014).

The main reason the majority of the respondents did not know about these laws is that the frameworks governing small-scale sand mining in South Africa more especially in deep rural areas like Mentz Village, lack the necessary financial and proper implementation capabilities to support better environmental compliance, and the enforcement mechanisms to successfully deter illegal activities are weak. These evaluations and implementations of sand mining's cumulative impact on the receiving environment should inform permitting decisions, with more careful consideration given to ensuring that extraction limits do not exceed the natural yield.

For sand miners and surrounding community members to be informed and know these laws, there is a need for a more comprehensive national intervention of legal operations to ensure that sand mining is kept within the ecological limits and sand budgets are respected and enforcement closely monitored. The authorities should effectively use the National Environmental Management Act of 1998 (NEMA) to regulate certain environmental aspects of sand mining.

5.6.2 The importance of rehabilitating the sand mines

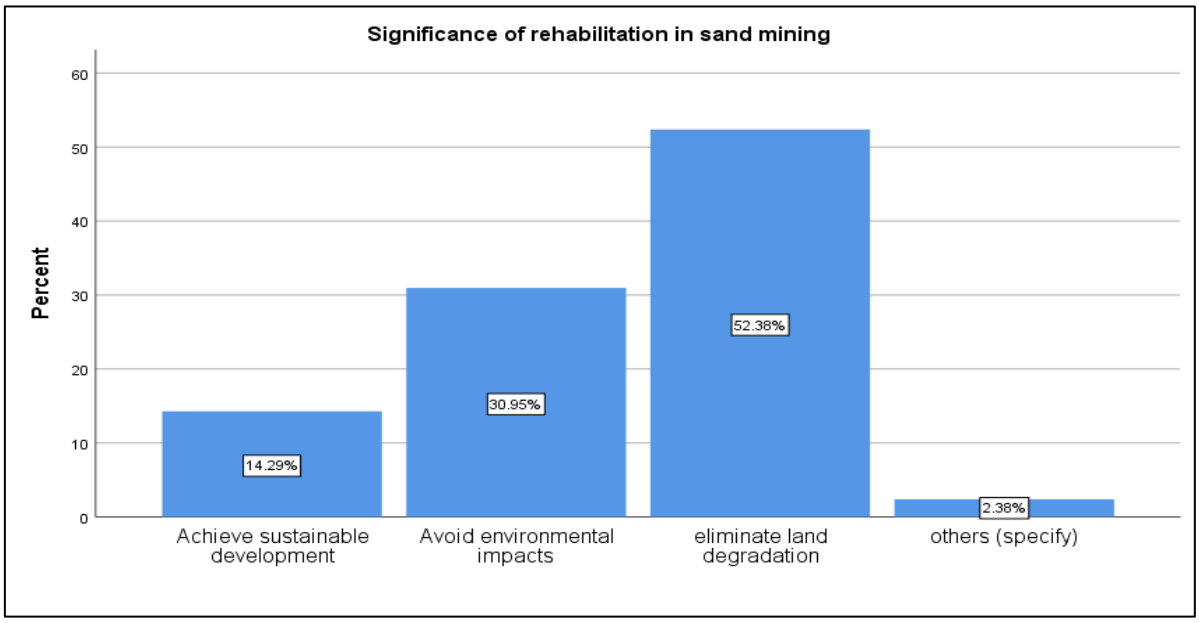

Figure 15: The importance of rehabilitation of sand mining area

Figure 15 illustrates the respondents' responses regarding the question that was asked if they see the significance of rehabilitation in sand mining. The majority (52.38%) of the respondents stated that rehabilitation after the process of sand mining is significant as it will eliminate land degradation and 30.95% stated that rehabilitation after the sand mining process helps to avoid environmental impact. The other 14. 29% stated that rehabilitation will assist in ensuring sustainable development whereby the needs of the current generation can be met without compromising the needs of the upcoming generation. The other 2.38% stated that rehabilitation is important since the sand miners may be granted access by the Chief of the area if they rehabilitated the area after use to avoid illegal sand mining. As a matter of fact, rehabilitation is part of the sand mining or mining permits issued by the government under section 41 of the National Environmental Management Act of 1998. If the miner fails to rehabilitate or manage any negative impact on the environment, the municipality may then use the financial provision to rehabilitate or manage the negative environmental impact in question.

Although legislation is now in place, implementation and enforcement is still a challenge. The establishment of an Inter-Departmental Project Implementation committee comprising of the Department of Environmental Affairs, the Department of

Mineral Resources, and the Department of Water and Sanitation, has its own challenges and a consolidated Management Report on how recommendations will be attended to was prioritized. The non-rehabilitated areas are considered a death trap for small children below the age of 10 years. One example was the case where a 9-year old child falling to his death in an open mine pit, in an illegal sand mining in old and abandoned mines. A total of 0.7% has been rehabilitated and 3.2% is a high priority to be rehabilitated. Sand mines are estimated to be around 245 sand mines. In the Northern Cape, 13 sand mines were rehabilitated, seven were rehabilitated in Limpopo and two in KwaZulu-Natal. The image below is an illustration of how the sand miners leave the place where they mine sand and this states the significance of why rehabilitation is of paramount importance to avoid such environmental impact.

Image 7: An example of the impact of sand mining on the environment

Source: Images obtained during the fieldwork

As can be seen in the image, after the activities of sand mining have occurred the environment is left degraded and cannot be used for other useful activities. This is a scenario that calls for rehabilitation efforts. The efforts to rehabilitate an area where sand mining has occurred is explained in the section that follows.

5.6.3 Ways to rehabilitate the sand mining sites after mining

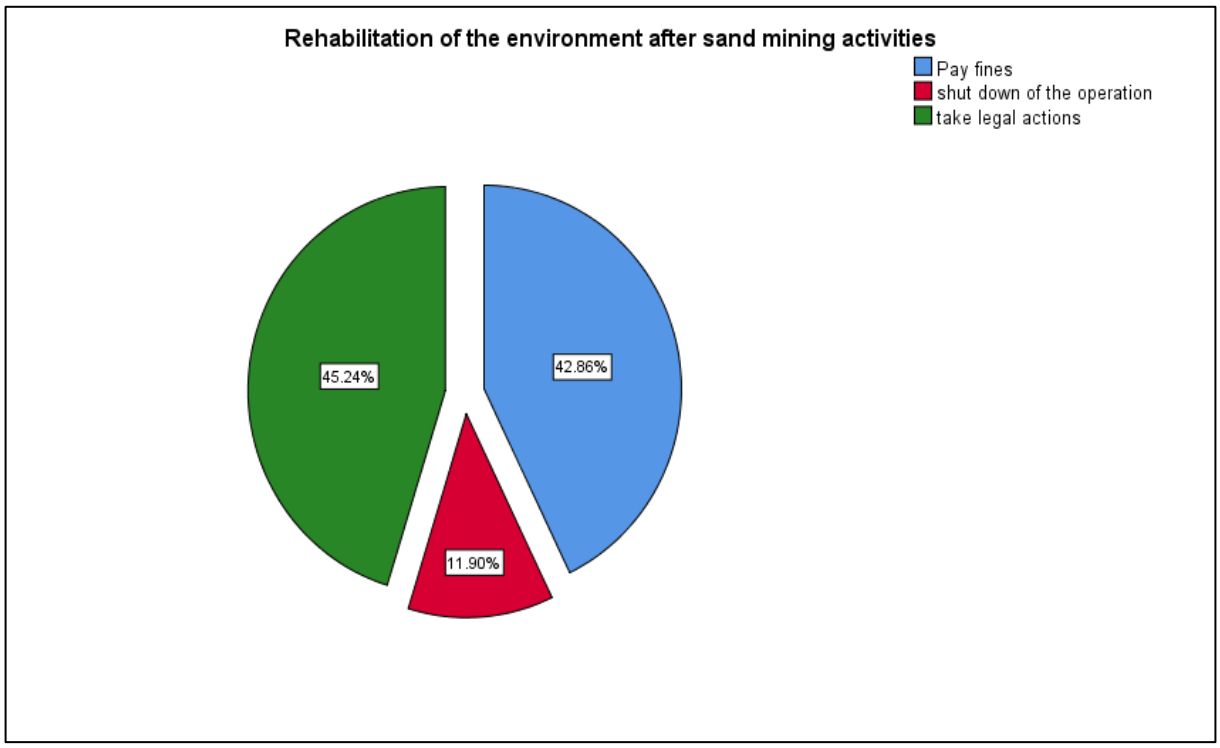

Figure 16: Ways to rehabilitate the sand mining sites after mining

Figure 16 Illustrates the respondents' responses to the question whereby people were asked about what should be done if the sand miners do not rehabilitate the area after the sand mining extraction. According to the response of the people who took part in the questionnaire survey, 42.86% of the total number of 42 people stated that the sand miners should be fined when they do not rehabilitate the area after extracting sand', in accordance with NEMA. Thus, the majority of the respondents, which constituted 45.24% stated that there should be legal action taken against these sand miners when they do not rehabilitate the area where sand is extracted 'this legal action should not only include fine but should also include imprisonment' while 11.90% of respondents stated that they should shut down their operations.

Furthermore, most of the respondents (45.24%) stated that legal action should be taken against these sand miners because they leave the pit wide open and this is risky during rainy seasons because children swim in those pits during the rainy season. One of the respondents stated that "pit holes are dangerous to the society. During rainfalls, the land becomes filled with water and children can start playing in the water, where they can drown".

5.6.4 The importance of rehabilitating the sand mines after mining

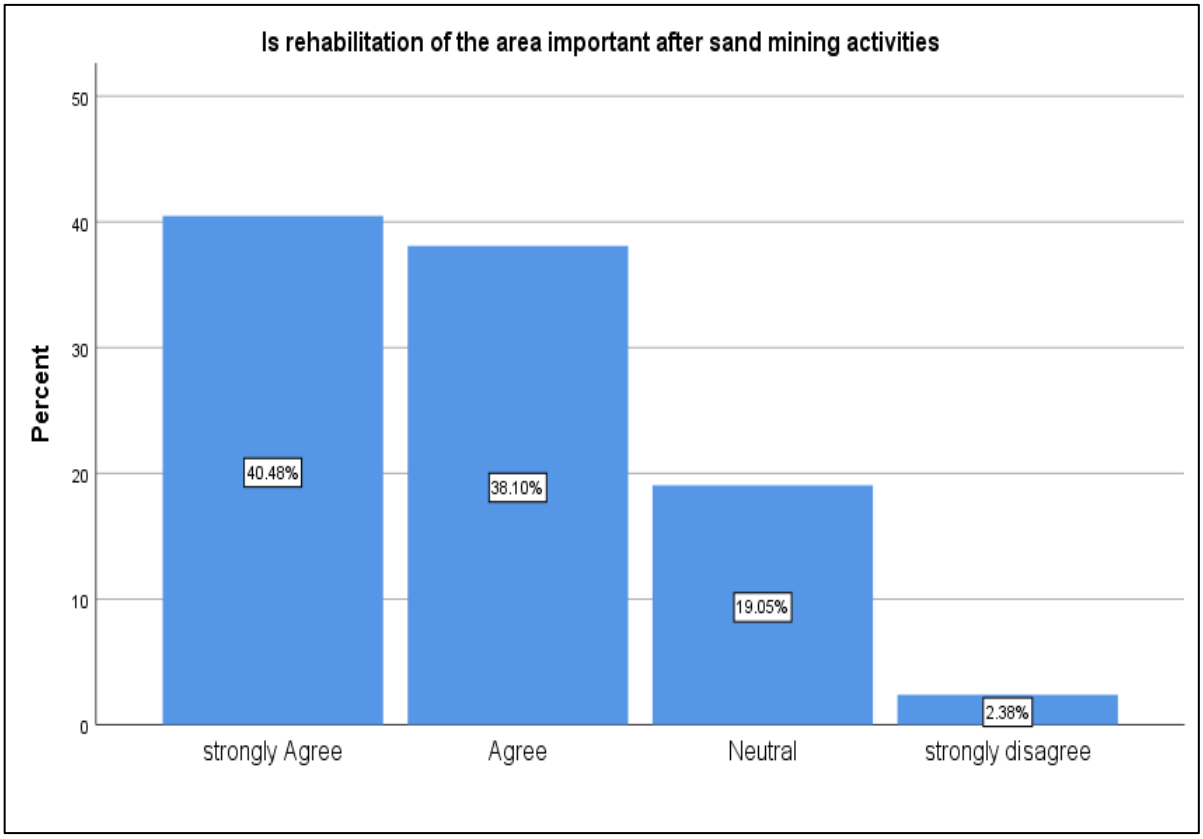

Figure 17: The importance of rehabilitation after sand mining activities

Figure 17 above illustrates the importance of rehabilitation after sand mining processes have taken place and 40.48% of the respondents stated that they strongly agree that rehabilitation should be encouraged after the mining of sand in the area. Whilst, 36.10% of the respondents stated that they "agree" that the land should be rehabilitated after sand mining processes and 19.05% of the respondents stated that they are neutral about the issue of rehabilitation after sand mining. The remaining 2.38% stated that they do not agree with the significance of rehabilitation of the area after sand mining has taken place. However, this might be because the respondents are not mainly affected by the sand mining activities and they also stay far away from where sand is extracted. A follow-up question was asked regarding the recommendation to ensure that rehabilitation is done by the sand miners whereby one of the respondents stated that "the land must be filled again. There must be an agreement between the sand miners and community representatives on how these will be done". According to Madyise (2013), rehabilitation is important as this will help achieve sustainable development and avoid environmental impact.

5.7 Mitigation of the impact of sand mining

Sand mining is essential for the nourishment of human life as it provides job opportunities and income, and enhances the local economy. However, sand needs to be mined in a more accountable and sustainable manner. Based on the major issues that emanated from this research, the following mitigation measures have been suggested to address the problems: Compliance with legislation and regulations on sand mining is mandatory and the necessity for responsible and sustainable sand mining. In this regard, the present and future legislation and regulations should be tailor-made for the sand mining sector and it should be simplified for an ordinary man to comprehend and adhere to. Mitigation must occur concurrently with sand and gravel extraction activities. Restoration is, therefore, a part of mitigation and the aim of restoration should be to restore the biotic integrity of a riverine ecosystem, not just to repair the damaged abiotic components. A well-known mitigating measure applied at various locations around the world is selecting sand mining areas, which will cause the least environmental damage because the damage will be about 10%, making it easy to rehabilitate.

It is equally important to note that other academics such as Brooks, et al. (2004) and Pillay et al. (2014) believe that alien species exert a significant impact on many ecological variables. In order to reduce environmental risks and vulnerability, sand miners need to first remove vegetation properly and store it somewhere for further use during rehabilitation. Sand miners should properly fence their sites to prevent accidents such as animals falling into the mine pits. Sand miners should also consider proper methods of mining that will reduce or mitigate soil erosion. Rehabilitation after mining is highly recommended and should be used as one of the conditions for issuing sand mining certificates. Alternative sources of livelihood such as farming should be encouraged for these rural communities. Reuse and recycling of old, building material must be encouraged by authorities as a way of reducing over-extraction and dumping of waste on the environment. Restriction of mining time and days to normal working hours that is 07:30-16:30 on weekdays is important to reduce illegal mining when there is tight security. Regular meetings and consultations with affected communities are important to call for their involvement in mining activities.

In order to mitigate some of the environmental effects that are commonly experienced on the site, the community members should apply several methods. For example, one of the most common environmental problems that are experienced on the site includes the destruction of the road, which is caused by the trucks when they come onto and out of the site. As a mitigating measure, the community members use wood and stones to fill up the holes and reduce further soil erosion and land sliding. This study also identified a need for consideration of scientific management methods when carrying out road maintenance on the site as well as a need to register the entities that are carrying out sand mining so that they can pay tax to contribute towards local economic development.

It is worth noting that most of the individuals that join sand mining are or were poor with no other alternative source of livelihood and that the activity presented a readily accessible source (most mentioned lack of other work alternatives as to the reason for joining). The contribution of the activity to household welfare should be considered since it allows some people to be better off; thus, some of those involved have consumption levels that are above the poverty line. This is considered valid because most of the sand miners do not have other alternative sources of income. Considering that construction works are ongoing, this could present a more than short term livelihoods strategy for the miners although the process could be improved and made more profitable with intervention in terms of better equipment.

Effective legal framework, strict laws and legislature are important as this will help impose heavy fines including long jail terms to miners who extract without mining rights and licenses. This is possible if trucks transporting sand and gravel pass through community leaders for inspection and verifying genuine permits to reduce the use of fake documents. One way to reduce the consumption of sand is to charge the sand miners for the mining of sand and the money raised there to be used for rehabilitation. There are also alternatives to concrete for building houses, including wood, straw and recycled material. However, the current building industry is geared toward concrete expertise and equipment. Training of architects and engineers, new laws and regulations, and positive incentives are needed to initiate a shift for lowering our dependency on sand. Renewable and recycled materials need to be a target for building houses and roads.

5.8 Summary and Conclusion

Sand mining is an important activity to economic development in both developing and developed countries. Although sand mining plays a pivotal role in the socio-economic and sustainability of livelihoods, it comes with greater cause to the environment. Sand mining activities cause environmental impact. As most of the mining of resources is done, most of the negative impact cannot be reversed and there is a permanent change to the environment, habitats and species that will make it difficult for sustainable development to be achieved.

Through proper education, implementation of policies and accountability, some of the issues or damages caused to the environment by sand mining can be either mitigated or reduced. The frameworks governing small-scale sand mining in South Africa lack the necessary financial and human resource capacities to support better environmental compliance, and the enforcement mechanisms to successfully deter illegal activities are weak. Consequently, there has been a flurry of new entrants to the sector, creating a system fraught with social, environmental, legislative and structural challenges. This matter deserves urgent attention and prioritization from the government, especially when one considers the non-payment of royalties to the state and the lack of mandated restoration activities. These challenges need to be viewed in conjunction with the resultant ecological and social damage.

The lack of proper scientific methodology for river sand mining has led to indiscriminate sand mining while weak governance and corruption have led to widespread illegal mining. The lack of adequate information is limiting the regulation of extraction in many developing countries. Access to data is difficult, and data are not standardized. Except in the European Union, regulation efforts are few, especially in developing countries. In chapter six (6), the discussion will be about research findings, recommendations and conclusions drawn from the research study.

CHAPTER SIX

RESEARCH FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

6.1 Introduction

This chapter brings to light the conclusions and recommendations relating to the research objectives and the findings of chapter five (5). The chapter presents the conclusions drawn from the research findings and gives recommendations on sand mining, land degradation and the significance of rehabilitation in rural areas of South Africa.

6.2 Summary of the research

Chapter 1 outlined the introduction as it introduces the reader to the content of the proposal. Secondly, the chapter presents the problem statement as it traces the genesis of the problem statement, research aim, research questions, and research objectives, the definition of terms, literature review (four themes of the study), and limitations of the study, the structure of the dissertation and the summary of the study.

Chapter 2 discussed sand mining, land degradation and rehabilitation in international countries and how sand mining activities trigger tensions between the government and the community members in these countries worldwide. This chapter discussed how in as much as sand mining and its activities serves as a source of livelihoods for the entire communities whilst on the other hand, triggers conflicts and the violation of human rights.

Chapter 3 covered a literature review of sand mining in South Africa, this was done by giving the readers the understanding of the conceptualisation of sand mining and land degradation. Further, the researcher explored the effects of sand mining in South Africa in particular rural areas. The researcher also tackled the rehabilitation of the land after sand mining has taken place.

Chapter 4 discussed the research methodology adopted to investigate the impact of sand mining on land degradation and the significance of rehabilitation in Mentz Village. This included aspects such as research design, sampling, data collection, data

analysis and ethical considerations. The study also explained the scope of the study area and the background of the study in the research.

Chapter 5 discussed data analysis and interpretation. The research explored the objectives set when the research was embarked on. Firstly, this chapter examined the nature of sand mining in Mentz Village; it assessed the nature of land degradation; it explored how sand mining causes land degradation, and it examined the significance of rehabilitation in sand mining.

Chapter 6 provides a summary of the study, research findings and what conclusions have been reached, as well as recommendations to the councillors, the Chief and the sand miners.

6.3 Research findings

The research aimed to investigate the impact of sand mining, land degradation and the significance of rehabilitation after the process of mining sand in Mentz Village. The specific research objectives for the study were to examine the nature of sand mining, examining both the negative and positive impact of sand mining, and assess the nature of land degradation. The study on the impact of sand mining and gravel extraction in Mentz Village highlighted the views of affected people through questionnaires and interviews.

The majority of the respondents were not happy with environmental degradation, accidents caused, waste disposed of by miners, threats from illegal miners and general damage to the ecosystems. The respondents that benefit from sand mining displayed interest in sand mining while on the other hand, those who do not benefit from it were totally against it. The study was on the impact of sand mining and the significance of rehabilitation in Mentz Village. It highlighted the views of affected people through questionnaire surveys and interview schedules. The majority of the respondents were not happy with environmental degradation, accidents caused, threats from illegal miners and the negative environmental impact caused by sand mining activities. The dissertation had four (4) research objectives.

To examine the nature of sand mining, this objective looked at the nature of sand mining and how they mine sand in various countries, South Africa and Mentz Village

as a case study. The findings of the study revealed that other countries monitor the sand mining activities and there are areas preserved for sand mining activities. However, the findings show how various countries deal with sand mining activities and their regulations. Sand mining in Mentz Village is not regulated and there is a huge development when it comes to the building of houses, infrastructural development and other aspects that demand the use of sand. Thus, there is an increasing demand for sand for developmental purposes in the area.

The research justified that there are both the positive and negative environmental impact of sand mining. The researcher discovered that pits at extraction sites were increasing because the most commonly used method of mining is open pit. Mining is an important activity for economic development in both developed and developing world. Generally, mining interrupts land surface areas, leaving huge open pits which are difficult physically and economically to rehabilitate after the sand mining activities. Excessive mining leads to the depletion of resources on the open lands.

To assess the nature of land degradation, this objective aimed at checking the effects of land degradation and if whether sand mining is the contributing factor of land degradation. Land degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land. It is viewed as any change or disturbance to the land perceived to be deleterious or undesirable to the environment. For this study, the findings revealed that one of the causes of land degradation is the excessive demand for sand where sand mining takes place. There is an increasing rate in terms of development in Mentz Village, so does the demand for sand for construction, which leads to land degradation.

To explore how sand mining causes land degradation, this objective aimed at exploring how sand mining causes land degradation. Mining adversely affects the environment by inducing loss of biodiversity, soil erosion, and contamination of surface water, groundwater, and soil. It is important to note that for sand mining processes to take place there must be the use of trucks and bulldozers.

The findings in the study regarding this theme are that the majority of the respondents expressed their concern about the environmental land degradation, accidents caused;

waste disposed of by the miners, threats from illegal sand miners and the general damage to the ecosystems. One of the major causes of land degradation is sand mining since sand is extracted from the environment. However, agricultural activities also cause land degradation as fertile soil is lost every year.

To establish the significance of rehabilitation in sand mining, this last objective aimed at establishing the significance of rehabilitation after sand mining processes. The findings reveal that rehabilitation is important after sand mining activities. The findings also state that sand mining activities must be regulated to achieve sustainable development and protection of the environment.

The findings of the study when it comes to the issue of rehabilitation in sand mining is that most of the sand miners do not rehabilitate the environment after sand mining activities. It was found that they leave the area not rehabilitated and during rainy seasons it becomes a breeding place for mosquitoes, the holes become a swimming place for the children in the area, which will cause harm to the children. One of the findings in the study regarding rehabilitation is that most of the places where sand miners mine sand is next to the households and with no rehabilitation measures in place, it becomes a problem because they experience land degradation.

The research revealed that one way to reduce the consumption of sand is by optimising the use of existing buildings and infrastructure. Recycled building and quarry dust material can be a substitute for sand. Despite the very high value of minerals found in the sand, it is mostly used for concrete or is buried under highways. Concrete rubble should be recycled to avoid using aggregates, at least for low-quality uses. Recycling glass bottles would also reduce sand consumption. There are also alternatives to concrete for building houses, including wood, straw and recycled material. However, the current building industry is geared towards concrete expertise and equipment. Training of architects and engineers, new laws and regulations, and positive incentives are needed to initiate a shift for lowering our dependency on sand. Renewable and recycled materials need to be targeted for building houses and roads.

The current situation will continue unless sand extraction is correctly priced and taxed so that other options become economically viable. Because sand is still very cheap, sand itself is freely accessible, only extraction costs need to be covered there is little

or no incentive to induce a change in our consumption. Alternative sources of sand and gravel, such as those that accumulate at the bottom of dams, can also be targeted. Large amounts of water must regularly be released from dams to flush out sand, although currently more expensive, these aggregates could be extracted from the dams. Their use would address the problem of their accumulation, which leads to a reduced capacity of dams to store water and could result in the dams' water intakes being blocked.

Local environments should be studied to define the limits of acceptable changes. The implementation of a monitoring mechanism regarding global aggregate extractions and trade would shed light on the magnitude of this issue and bridge the current data and knowledge gap. This would also raise this issue on the political agenda and perhaps lead to an international framework to improve extraction governance, as the current level of political concern clearly does not match the urgency of the situation. There is thus a need for regulating sand extraction in both national and international waters and it should be authorized only after sound scientific assessment shows there would be limited impact on the environment. Greater consideration of substitute and sustainable use of the resource could drastically reduce the impact on the environment. Other policy actions include the introduction of scientific mining operations, followed by ecological restoration. Furthermore, because of sand's dynamic nature as a source, its extraction needs to be viewed as part of a broader system. Sand mining is an extractive activity in that the stock of the resource decreases as it is used.

The sustained future demand for sand by the construction industry will only perpetuate the existing situation, where the mining rate exceeds the natural rate of replenishment, resulting in a decrease in sand reserves. It is, therefore, imperative to better understand the sand yield for particular river systems and limit upstream extractive activities that will have a negative downstream impact. These challenges need to be viewed in conjunction with the resultant ecological and social damage. Better enforcement is needed to discourage illegal activities and eventually prohibit the extraction of all river and estuarine sand while seeking other sources of sand for the construction industry.

6.4 Recommendations

The study makes recommendations on measures that can be implemented to reduce the negative effects of sand mining on the environment. The recommendations below can be adopted and/or adapted by governmental institutions such as the Department of Minerals and Energy, Department of Environmental Management Services and Local Municipalities, to establish policies that seek to promote sustainable development and govern such mining activities.

To reduce the negative effects of sand mining on the natural environment and the surrounding villages, the processes of dry-pit method of sand mining, reclamation of contaminated soils, replantation of appropriate vegetation can be useful in that regard.

To reduce the effects of land degradation which is a resultant of sand mining, efforts should be geared towards the regulation of sand extraction and the promotion of EIAs by the relevant authorities: Government departments and local municipalities, so that permits and licences can be issued for sand mining, together with tariffs.

Since the nature of sand mining revealed that most participants are illegal miners, in order to deal with the illegal sand miners, it is recommended that emphasis be placed on registration and documentation of the sand minors so that the regulatory bodies can allocate spaces for sand mining, accordingly, failure to comply should result in either heavy fines, shutting down of the sites or prosecution against the trespassers.

In a bid to promote the significance of rehabilitation, it is recommended that strict measures be implemented to promote the restoration of the biotic ecosystem.

In an effort to address all the identified adverse effects of sand mining and land degradation, strategies to promote other income-generating activities like agriculture and agro small-scale industries may reduce pressures on sand mining, thus helping to improve the social, economic and environmental management of natural resources.

There is a need for further research to establish the actual effects of sand mining by ascertaining the status quo before and after sand mining has occurred in a particular place.

The researcher also made recommendations to both the decision-makers who are directly involved in the evaluation of sand mining activities to make informed decisions when issuing licenses and to miners considering the rate of illegal mining in the country. More recommendations are on areas, which need further research and scholarly publications for government departments to read.

6.4.1 Recommendations for decision-makers

The Department of Mineral and Energy should issue licences to miners to regulate them and that they pay the necessary tax. This will help in knowing who to challenge with lack of rehabilitation and they could pay in case the municipality or the government department has to rehabilitate the area as it is done in the USA as discussed in chapter two.

Also as discussed in the literature review chapter, it is important to have an Environmental Assessment Management and Monitoring Program and monitoring that ensures that there are proper mining processes taking place in the area and miners are issued with mining permits.

The arrangement of 24-hour security to guard mining areas and stop illegal miners with the help of village watch groups. All residents must be involved in stopping and reporting illegal miners to authorities instead of supporting them.

Authorities are to strengthen laws on not allowing people to enter vulnerable areas through close monitoring of the mining activities in all areas.

Control of mining time and days to normal working hours that is 07:30-17h00 on weekdays is important to reduce illegal mining when there is tight security.

Regular meetings and consultations with affected communities are important to call for their involvement in mining activities. Part of royalties can be paid to village committees so that villagers can directly benefit from mining activities in their areas.

The impact of such areas represent both ecological and economic impact; therefore, any proposed activity should be examined carefully to weigh the consequences for both public and private interest.

There should be signboards prohibiting illegal mining such as the one for illegal dumping. There must be increased signs by the Department of Environmental Affairs and placed next to all mining and surrounding areas prohibiting illegal mining, dumping of waste, for example, the boards must be made like the “no dumping” boards for environmental management purposes.

The government should aim at providing technical support to local mine stakeholders such as training in facilitation and management tasks to local stakeholders.

Strategies to eliminate illegal mining and to promote other income-generating activities like agriculture and agro small-scale industries may reduce pressures on mining, thus helping to improve the social, economic and environmental management of natural resources.

6.4.2 Recommendations for miners and community members

Consultations and seeking permission from interested and affected communities before mining is important as sand miners should consult chiefs, sub-chiefs and village committees to control the size of the area mined and reduce damage to the environment. Regular meetings between the Department of Mines and village leadership can be a good platform for consultations. The village leadership will be involved in surveying and recommending the areas to be mined far from where agricultural activities take place

As this issue is a major emerging one, there is a need for in-depth research. The implementation of a monitoring mechanism regarding global aggregate extractions and trade would shed light on the magnitude of this issue and bridge the current data and knowledge gap. This would also raise this issue on the political agenda and perhaps lead to an international framework to improve extraction governance, as the current level of political concern clearly does not match the urgency of the situation.

Miners must change mining areas and not extract from the same area continuously but must have alternative sites to reduce overexploitation and environmental damage beyond rehabilitation. Sand mining should not be done near schools, clinics, residential areas or any sensitive areas. There must be a segregated area where sand miners mine sand.

Controlling the time of mining: not to be done throughout the year but during the dry season, avoiding rainy season. This is necessary to give the land time to rehabilitate and recover. Mining time must be restricted to daytime only.

Mining should be done approaching the floodplain from one side to minimize crossing riverbed with heavy machinery. Access to rivers can be determined by steepness and vegetation available to avoid damaging flora. If the channel is too deep, construct access ramps.

Access roads from public roads must be parallel to the riverbanks to restrict water flowing along the tracks during the rainy season from forming gullies.

Covering sand and gravel with nets: when transporting the resources to be a prerequisite to reduce the damage of other motorists' windscreens from falling stones.

All miners must cover and refill pits after mining as reclamation since mitigation and restoration must occur concurrently with extraction activities to conserve the biotic integrity of ecosystems.

The miners must do reclamation of contaminated soils around all mining areas. Stockpiling to be avoided on riverbeds and open areas.

Miners must plant and establish appropriate vegetation to reduce erosion on reclaimed land.

All miners must use the dry-pit method of mining in all their extraction activities since the depth of mining can be controlled. The method should not be used on one area for too long but substitute areas of mining.

6.4.3 Recommendations for further research

The study was not exhaustive and the researcher observed that more research on the topic is necessary for the following areas:

- Interviews are to be done with more people from various departments.
- More research must be done during both rainy and dry seasons to compare results.

- More time, for example, a year can be allocated to conduct the research to cover more areas.
- More sampled points in various rivers and open areas countrywide are to be used to determine the extent of environmental damage. More researches to be done to find alternative resources to river sand such as crushed stone from quarries.

6.5 Summary and Conclusion

There is a need to enforce laws across the globe by high-level decision-makers to. Sand mining contributes to the construction of buildings, infrastructure development; it helps in extracting minerals and provides both economic and social benefits. However, intensive sand mining with disregard to environmental protection erodes these gains and creates a series of environmental problems. The regulatory agenda prepared for sand mining is passive and this make enforcement complicated. Lack of clear guidelines for dealing with sand mining operations coupled with the inability of the regulatory authorities' results in unscrupulous sand mining activities and environmental degradation. There is a need to rehabilitate the environment after sand mining activities to avoid environmental impact.

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APPENDICES

Appendix 1: Approval of Proposal

University of Limpopo
Faculty of Management and Law
OFFICE OF THE EXECUTIVE DEAN
Private Bag X1106, Sovenga, 0727, South Africa
Tel:(015) 268 2558, Fax: (015) 268 2873, Email: johannes.tsheola@ul.ac.za

13 June 2017

D.S Malebana (201211454)
SCHOOL OF ECONOMICS AND MANAGEMENT
MASTERS OF DEVELOPMENT STUDIES (Planning and Management)

Dear Ms Malebana DS

FACULTY APPROVAL OF PROPOSAL

I have pleasure in informing you that your Masters proposal served at the Faculty Higher Degrees Committee meeting on **13 June 2017** and your title was approved as follows:

"Sand Mining, Land Degradation and Rehabilitation in Rural Areas of South Africa: A Case of Mentz Village, Limpopo Province"

Note the following: The study

Ethical Clearance	Tick One
Requires no ethical clearance Proceed with the study	
Requires ethical clearance (Human) (TREC) (apply online) Proceed with the study only after receipt of ethical clearance certificate	√
Requires ethical clearance (Animal) (AREC) Proceed with the study only after receipt of ethical clearance certificate	

Yours faithfully

15/06/17

Prof MP Sebola
Chairperson: Faculty Higher Degrees Committee

CC: Supervisor, Dr MN Khwela, Mrs MD Mathebula, HOD and Prof MP Sebola Acting Director, School of Economics and Management

Finding solutions for Africa

Appendix 2: Consent Letter

CONSENT LETTER

To: TREC Committee
From: Ms DS Malebana (201211454)
Date: August 10. 2017
Subject: Consent Letter for TREC Application

To whom it may concern,

I Dineo Sarah Malebana (201211454) I'm a Masters student in the Department of Development Planning and Management (DDPM) doing my second year. In the process of data collection the participants will be informed of their rights and that their participation in the study is voluntary and if they feel they do not want to respond to certain questions they may do so. One of the other ethical considerations that will be taken into account is that the issue of anonymity of the respondents is also guaranteed. The names of the participant will not be used during the writing up of the report and the researcher will also request their permission for the use of data for other purposes such writing an article for publication. Moreover, participation in the study will also be voluntarily and the respondents will also have the right to withdraw from the study at any time. The researcher will be visiting the sand mining projects of the sand miners in Mentz area and establish a relationship with them by firstly informing them about the proposed study, their involvement, as well as to use their projects for this study for academic purposes.

Hope all is in good order. Thank you.

Signed: Malebana 10/08/2017

DS Malebana (201211454)
Masters Student in Development Planning and Management

Finding solutions for Africa

Appendix 3: Ethics Clearance

University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 2212, Fax: (015) 268 2306, Email:noko.monene@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE CLEARANCE CERTIFICATE

MEETING:	02 November 2017
PROJECT NUMBER:	TREC/306/2017: PG
PROJECT:	
Title:	Sand Mining, Land Degradation and Rehabilitation in rural areas South Africa. A case of Mentz Village, Limpopo Province
Researcher:	DS Malebana
Supervisor:	Dr MN Khwela
Co-Supervisor:	N/A
School:	Economics and Management
Degree:	Masters in Development Studies

PROF TAB MASHEGO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: REC-0310111-031

Note:
i) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
ii) The budget for the research will be considered separately from the protocol.
PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

Finding solutions for Africa

Appendix 4: Questionnaire

APPENDIX A: THE RESEARCH QUESTIONNAIRE SURVEY FOR THE SAND MINERS AND HOUSEHOLDS IN MENTZ VILLAGE

RESEARCH QUESTIONNAIRE

This questionnaire is designed to survey individuals for the research project on, "Sand mining, land degradation and rehabilitation in rural areas of South Africa. A case of Mentz Village". The research project is registered with the Department of Development Planning and Management, University of Limpopo, Turfloop Campus. Please assist by providing information required in this questionnaire.

Please take into consideration the following:

- The information collected will not be used against the informants or rather the participants
- The issue of anonymity is guaranteed (names will not be mentioned)
- Permission to conduct research will be asked and if the respondents feel the need to withdraw from the interview, they are welcomed to do so.
- Participation for all the people will be voluntary and the information will be solely used for academic purposes.

Researcher	Respondent
Date	Date
.....	.....
Signature	Signature
.....	.....

Thanking you in advance

SECTION A: Demographic Profile

1. What is your age group? Please identify with a tick.

1.1. 20 years-30 years	
1.2. 31- 40years	
1.3. 41-50 years	
1.4. 50 and above	

2. What is your gender group?

2.1 Male	
2.2. Female	

3. What is your population group?

3.1. Black African	
3.2. White	
3.3. Coloured	
3.4. Indian or Asian	
3.5. Other (specify)	

4. What is your current educational status?

4.1. Primary level	
4.2. Secondary level	
4.3. Tertiary level	
Others (Specify)	

5. What is the current employment status? (Please tick one option)

5.1. Unemployed	
5.2. Employed	
5.3. Seasonal Employment	
5.4. Casual Employment	
5.5. Other (Specify)	

SECTION B: The nature of sand mining

6. Do you participate in the sand mining activities that take place in the area?

6.1. Yes	
6.2. No	

7. How do you feel about sand mining and gravel extraction?

Very happy	1	Happy	2	Normal	3	Sad	4	Very sad	5

8. Does sand mining affect you as a resident in the area?

8.1. Yes	
8.2. No	

SECTION C: The nature of land degradation

9. Have you ever heard of any accidents reported during sand mining?

9.1. Yes	
9.2. No	

10. How do you think sand mining activities affect the degradation of the environment?.....
.....
.....
.....
.....
.....

11. Do you understand what land degradation means?

11.1. Yes	
11.2. No	

If yes, please explain.....
.....
.....
.....
.....
.....

12. Which of the following causes of land degradation would you regard as the most popular activities?

12.1. Sand mining [ ] 12.2. Gardening [ ] 12.3. Overgrazing [ ]

12.4. Deforestation [ ] 12.5. Others (specify) [ ]

SECTION D: The causes of sand mining on land degradation

13. Do you often visit the sand mining areas?

13.1. Yes	
13.2. No	

14. If yes, choose and tick some of the activities that you normally do at the sand mining activities.

14.1. Get domestic water	
14.2. Sand mining	
14.3. Herding livestock	

14.4. Farming	

SECTION E: The significance of rehabilitation in sand mining

15. Are there any proper guidelines that govern the sand mining activities?

15.1. Yes	
15.2.No	

16. What is the significance of rehabilitation in sand mining?

16.1. Achieve Sustainable development	
16.2. Avoid environmental impacts	
16.3. Eliminate land degradation	
16.4. Others (Specify)	

17. What can be done to ensure that the people who are practising sand mining rehabilitate the environment after the entire process?

17.1. Pay fines	
17.2. Shut down of the operation	
17.3. Legal actions	
17.4. Others (Specify)	

.....
.....
.....
.....
.....
.....
.....

18. Do you think it is important to rehabilitate the area after sand mining practices?

Strongly agree	1	Agree	2	Neutral	3	Negative	4	Strongly disagree	5

Thank you

Appendix 5: Interview Schedule

APPENDIX B: INTERVIEW SCHEDULE FOR THE KEY INFORMANT(S)

RESEARCH INTERVIEW SCHEDULE

FOR KEY INFORMANT(S) IN MENTZ VILLAGE

1. As the chief/ Induna of Mentz Village, when the sand miners want to start a sand mining business do you give them the permission?

2. Are there any protocols or procedures that must be followed before an individual or a household can open a sand mining project?

3. What are the environmental impacts caused by sand mining?

4. Do you think it is important for the sand miners to rehabilitate the area after they have extracted sand from the ground?

5. Are there certain areas where the sand miners extract sand from, or do they select their own places where they can extract sand?

6. Do the sand miners in the area pay any amount to be allowed access to operate their projects in Mentz Village?

7. How would you feel as a community that these sand miners compensate a certain amount that will be used to rehabilitate the environment?

8. As the Chief/Induna of the area, have you ever heard any reported accidents that are caused by sand mining operations?

9. How does sand mining affect the environment?

10. What is the significance of rehabilitation in sand mining?

Thank you

SEGOMARETŠWA B: LENANEO LA DIPOTŠIŠO LA BAKGATHA TEMA BA MALEBA BA MOTSENG WA MENTZ

1. Bjalo ka Kgoši ya Motse wa Mentz, ge batho ba go epa (ntšha) mohlaba ba nyaka go thoma kgwebo ya ya bona ya go epa (ntšha) mohlaba, a o ba fa tumelo naa?

2. A go na tshepedišo yeo e swanetšwego go latelwa pele motho goba lapa a thoma ka projeke ya moepo wa mohlaba naa?

3. Ke seabe se fe seo se hlolwago ke moepo wa mohlaba mo tikologong?

4. A o nagana gore go bohlokwa gore batho bao ba epago (ntšhago) mohlaba ba tsošološe lefelo leo morago ga go epa (ntšha) mohlaba naa?

5. A go na le lefelo leo batho ba go epa (ntšha) mohlaba ba hwetšago mohlaba gona, goba ba ikgethela lefelo la bona moo ba ka kgonago go epa (ntšha) mohlaba naa?

6. A e ka ba batho bao ba epago (ntšhago) mohlaba mo nageng ye ba a lefa tšhelete ye e itšego gore ba kgone go epa mo motseng wa Mentz naa?

7. Bjalo ka Kgoši ya naga, a o kile wa kwa ka kotsi yeo e angwago ke moepo wa mohlaba naa?

8. Nna moepo wa mohlaba o ama bjang tikologo?

9. Nna tlhalošo ya tsošološo ya moepo wa mohlaba?

Ke a leboga

KGORO YA VEERFONTEIN/MENTZ

P O BOX 01

SOVENGA

0727

Ntona MAMABOLO M.A

KGOSHI M.R MAMABOLO

Enquiries

M.A. MAMABOLO

Contact

076 572 6146

THOBELA

RELEKGORO LE SETŠHABA RE DUMELE TSE KAMALEBANA DINEO SARAH ID: 931216 0710 083

O FILWE TUMELELO YA MOŠOMO WA GAGWE WA GOLEBELELA BA SAND MINING – BAEPI BA MMU GORE MA BA ŠOMA KA MOKGWA WA MALEBA NAA. GE GO SE BIALO, BA TLA FIWA TLHAHLO YA GO GORE RE NTŠHA MMU KA TSELA YA GORE LE GORE.

Secretary

Chairperson

Ntona