AN ASSESSMENT OF THE ENVIRONMENTAL MANAGEMENT PRACTICES AND ASSOCIATED CHALLENGES FOR ARTISANAL AND SMALL-SCALE MINING (ASM) IN TANZANIA: A CASE OF NYAKAFULU GOLD RUSH IN MBOGWE DISTRICT, GEITA REGION

ERNEST KAFU

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENVIRONMENTAL SCIENCES

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CERTIFICATION

The undersigned certifies that she has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation titled ***"An Assessment of the Environmental Management Practices and Associated Challenges for Artisanal and Small-Scale Mining (ASM) in Tanzania: A Case of Nyakafulu Gold Rush in Mbogwe District, Geita Region"*** in partial fulfilment of the requirements for the award of the degree of Master of Environmental Sciences of the Open University of Tanzania.

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Dr. Irene Aurelia Tarimo

(Supervisor)

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Date

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DECLARATION

I, **Ernest Kafu,** declare that the work presented in this dissertation is original. It has never been presented to any other University or Institution. Where other people's works have been used, references have been provided. It is in this regard that I declare this work as originally mine. It is hereby presented in partial fulfilment of the requirement for the degree of Master of Environmental Sciences of The Open University of Tanzania.

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Signature

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Date

DEDICATION

I dedicate this project to my beloved wife and children who have been a great help in my studies by encouraging and allowing me to use their time and family resources to accomplish this dissertation.

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I am so grateful to the Almighty GOD. This work wouldn't have been a success without the mercy and guidance that he granted me throughout the research period, I would also like to give my special thanks to my supervisor, Dr Irene Aurelia Tarimo, for her enduring support and much-appreciated advice throughout my dissertation. Without her invaluable guidance, this project would not have been possible.

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ABSTRACT

This study assessed environmental management and the associated challenges affecting environmental management in Artisanal and Small-scale Mining in Tanzania: a case of Nyakafulu gold rush in Mbogwe district, Geita region. Framed based on the Stakeholder Theory, the study intended to specifically: identify challenges affecting environmental management in Artisanal and Small-Scale Mining (ASM); assess the level of environmental management compliance and practices in Artisanal and Small-Scale Mining (ASM) and to propose a framework for stakeholders' engagement in environmental management in Artisanal and Small-Scale Mining (ASM). A descriptive cross-sectional design was used to collect primary data from targeted 120 respondents. Data analysis for quantitative data involved descriptive statistics and multiple regression analysis using Ordinary Least Square (OLS) regression. Qualitative data was analyzed using thematic analysis. The study's findings revealed that the level of environmental management implementation by the ASM sub-sector is low at 26.8%. Moreover, it was found that low levels of environmental management practices are caused by lack of awareness (i.e. β= -0.144; $p \leq 0.1$), lack of specialists (i.e. β= -0.192; $p \leq 0.1$), lack of environmental management knowledge (i.e. β= -0.198; $p \leq 0.1$), and limited stakeholder pressure (i.e. β= -0.175; $p \leq 0.1$). The study thus concludes that the level of environmental management practice is low in the ASM sub-sector in Tanzania. Therefore, the study mainly recommends establishing an advocacy programme on the benefit of environmental management, particularly for artisanal and small-scale miners.

Keywords: *Challenges, Environmental Management, Artisanal and Small-Scale Miners*

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AMDC	Africa Minerals Development Centre
AS	Artisanal and Small Scale
ASGM	Artisanal and Small-Scale Gold Mining
ASM	Artisanal and Small-Scale Mining
BMFR	Bukombe-Mbogwe Forest Reserve
CSR	Corporate Social Responsibility
DEMATEL	Decision-Making Trial and Evaluation Laboratory
EIA	Environmental Impact Assessments
EM	Environmental Management
FEMATA	Federation of Miners Associations Tanzania
GDP	Gross Domestic Product
GGM	Geita Gold Mine
GST	Geological Survey of Tanzania
IFC	International Finance Corporation
IIED	International Institute for Environment and Development
ILO	International Labour Organization
IT	Information Technology
KIIs	Key Informant Interviews
KPI	Key performance indicator
LDC	Least Developed Countries
LSM	Large Scale Mining
MMSD	Mining, Mineral and Sustainable Development
NBS	National Bureau of Statistics

NEMC	National Environment Management Council
OLS	Ordinary Least Square
OUT	Open University of Tanzania
PML	Primary Mining License
PPE	Personal protective equipment
REMAs	Regional miners' associations
SAIIA	South Africa Institute of International Affairs
SDGs	Sustainable development goals
SLO	Social License to Operate
SPSS	Statistical Package for Social Science
STAMICO	State Mining Corporation
TCCIA	Tanzania Chamber of Commerce, Industry and Trade
UN	United Nations
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
URT	United Republic of Tanzania
VIF	Variance Inflation Factor

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Artisanal and Small-Scale Mining (ASM) is one of the significant economic activities in the World, estimated to employ around 20-30 million Artisanal and Small-scale (AS) miners Worldwide, with more than 100 million people depending on this sub-sector indirectly (Maddala *et al*., 2021). In developing countries, the ASM is a poverty-driven activity with more than 10 million people directly engaged in the sub-sector, a significant proportion of whom are women and children (Amoah & Eweje, 2022). ASM is three to five times more lucrative than other small-scale, poverty-driven economic activities, with an impact on both household income and contribution to local economies (Soe *et al*., 2022). For example, 200,000 ASM miners in Uganda contribute around 20 times more to GDP than foresters, fishers and farmers (Kimijima *et al*, 2022).

Similarly, Tanzania, despite its name, is not a small sector; the Artisanal and Small-scale Mining (ASM) currently employs over 2 million Tanzanians, with a further 9 million people depending on the sub-sector for their livelihood (Ministry of Minerals, 2022). Estimates suggest that more than 90% of miners in Tanzania are in the ASM sub-sector (STAMICO, 2022). For example, in 2022, the artisanal and small-scale miners contributed to 15% of the total annual gold production in the country (Ministry of Minerals, 2022). For years, the ASM in Tanzania has shown

great resilience and ability to reduce poverty amidst government crackdown, implying that better mining policies and their effective implementation are necessary.

Nevertheless, the sub-sector is perhaps better known for its high environmental costs and poor health and safety records. ASM's environmental impacts include erosion and deforestation of protected areas, biodiversity loss and water pollution from dumped tailings, alluvial river damage, acid rock drainage, and river siltation (Mutagwaba *et al*., 2018). Another problem of ASM is the large number of individual polluters, normally concentrated in a specific area, which causes significant local environmental impacts. Many consider it dirty and fundamentally unsustainable (Kinyondo & Huggins, 2021).

ASM has inherent health and safety risks, and the prospects of lucrative rewards incite greater risk-taking. For example, ASM for gold is the World's first worst mercury polluter, responsible for one-third of global mercury pollution (Cheng *et al*., 2023). ASM releases 1,400 tonnes of mercury annually from at least 70 countries (Wanyana *et al*., 2020). On average, 350 tonnes enter the atmosphere, and the rest is released into the hydrosphere (rivers, lakes, soils, tailings) (Kyaw *et al*., 2020). Mercury is discarded in tailings and released when gold–mercury amalgam is burnt during processing. Mercury impairs brain function, damaging coordination and memory, lowering intelligence, and causing hearing loss, congenital disabilities and miscarriages (Niedzielski *et al*., 2024). The risks are, therefore heightened for pregnant women, children and babies (Wanyana *et al*., 2020).

Although both the Large-Scale Mining (LSM) and Artisanal and Small Scale (ASM)

mining have dire environmental impacts, ASM releases 40 times more mercury per unit of gold produced than LSM (and five times more overall) (Mestanza-Ramón *et al*., 2022). Moreover, ASM gold mining using cyanide uses about twice as much per unit of gold produced as LSM (Saalidong & Aram, 2021). Thus, the environmental costs of ASM are generally higher than those of other types of mining. This means that ASM is dirtier per output unit than medium-sized or large and modern mining operations. It is therefore essential to maximize the benefits brought and enabled by small-scale miningand mitigate the costs.

In Tanzania, despite the contributions of the AS gold mining sub-sector to the economy, its negative effects, especially on the degradation of the environment, cannot be overemphasized. Many artisanal and small-scale miners use rudimentary equipment such as dredging boats, water pumps, pickaxes, shovels, mercury, and late excavator (Rwiza *et al*., 2023). The AS mining negatively affects the environment, eliciting the change and action needed to mitigate its harmful effects (Garinas et al., 2022).

Nonetheless, Tanzania's mining regulations and policies have addressed environmental management and impacts since the 1980s. However, until relatively recently, regulations focused on large-scale mining. Over the past decade, increased emphasis has been placed on the ASM. The Mining (Environmental Protection and Conservation) Regulations, 1999 were the first mining laws to address environmental issues in ASM expressly. They sought to protect water sources from contamination from mineral washing and settling ponds and pit latrines and from the removal of

vegetation from riverbanks; ban the use of mercury without retorts; ban the use of cyanide leaching without written permission and require PPEs for the use of such toxic chemicals; require proper disposal of tailings; and require the back-filling or fencing of abandoned mines.

Moreover, the 2017 Amendments to the 2010 Mining Act strengthened the environmental dimensions of Tanzania's legal framework. It stipulates that the Environmental Management Act (2004) applies to the mining sector. It required mineral rights holders to prepare annual reports that included environmental issues, particularly those prioritized by local authorities. Nevertheless, ASM in Tanzania has implemented or enforced few of these requirements.

Despite the existing environmental management challenges in the ASM sub-sector, implementing environmental management in the ASM sub-sector in Tanzania is important because there are unborn generations who will depend on the environment. Therefore, if the present abuse of the environment in the ASM sub-sector is not checked, it will lead to biophysical degradation (Moonsammy, 2021). The need for environmental management is urgent due to the deterioration of country life support systems. Improved environmental management is key to the achievement of sustainable development goals (SDGs). According to Kinyondo and Huggins (2020), ASM currently has a positive impact on four of the SDGs (Goal 1: No Poverty; Goal 7: Affordable and Clean Energy; Goal 9: Industry, Innovation and Infrastructure; and Goal 17: Partnerships for the Goals).

According to Ojo *et al.* (2021), environmental management in the ASM sub-sector in developing countries is highly affected by several challenges, raising concerns among policy makers and development partners. Ojo *et al.* (2021) outline the following challenges as being notorious in environmental management in the ASM sub-sector in developing countries: lack of awareness, difficulty with environment issues, lack of specialists, lack of EM knowledge, lack of leading initiatives, complex documentation process, high cost of EM implementation, negative attitude of artisanal and small-scale miners, ambiguity in legal interpretations, multi-layered sub-contracting, limited stakeholders' pressure, resistance to training and lack of EM training and education.

However, rigorous empirical testing to analyse the extent challenges' effect on environmental management in the ASM sub-sector in Tanzania is missing in the literature. Therefore, the current study sought to analyse the main environmental management challenges in ASM in Tanzania.

1.2 Statement of the Research Problem

Environmental Management (EM) for the promoting sustainable development and achieving SDGs has proven challenging for Tanzania's ASM sub-sector. The government and other development partners are struggling to implement environmental management policies and enforce regulations in the ASM sub-sector. Consequently, the ASM is becoming more destructive as it is the largest source of pollution in Tanzania. On the other hand, there is a dearth of empirical research to address environmental management challenges in Tanzania's ASM sub-sector.

This study, therefore, focused on an empirical examination of the challenges affecting environmental management in the ASM sub-sector in Tanzania using a case study of the Nyakafulu Gold rush in the Geita region, whereby a preliminary survey showed that it is one of the areas badly affected by the activities of the ASM. ASM has caused serious ecological problems in the Geita region due to the irresponsible use of mercury and poor production techniques. The Tanzanian government is aware of these environmental management problems, but managing and controlling them has proved quite challenging.

1.3 Research Objectives

1.3.1 General Research Objective

To assess the improvement of environmental management practices and associated challenges affecting the Artisanal and Small-scale Mining (ASM) operations in Tanzania.

1.3.2 Specific Objectives

i) To identify challenges affecting environmental management practices in Artisanal and Small-Scale Mining (ASM).

ii) To assess the level of environmental management compliance and practices in Artisanal and Small-Scale Mining (ASM).

iii) To propose a framework for stakeholders' engagement in environmental management practises in Artisanal and Small-Scale Mining (ASM).

1.4 Research Questions

1.4.1 General Research Question

Which improvements of environmental management practices and associated challenges affect the Artisanal and Small-scale Mining (ASM) operations in Tanzania?

1.4.2 Specific Research Questions

i) Which challenges affect environmental management practices in Artisanal and Small-Scale Mining (ASM)?

ii) What is the level of environmental management compliance and practices in Artisanal and Small-Scale Mining (ASM)?

iii) What is a proposed framework for stakeholders' engagement in environmental management practices in Artisanal and Small-Scale Mining (ASM)?

1.5 Relevance of the Research

The current study is relevant in the following areas:

Relevance to Practice: The usefulness of the research outcome might include the professional applications of the findings and recommendations in developing strategies that could remove challenges in environmental management. The generated information will also provide more enlightenment regarding the stakeholders' interests, and how organizational leaders and stakeholders could collaborate to promote environmental management and sustainability. The

government and environmental protection agencies will apply the research findings in developing environmental policies and regulations that might more adequately address environmental issues. Further researchers may find a turning point for more research of a similar nature.

Relevance to Theory: The existing literature on environmental management challenges has not addressed quantitative analysis in promoting environmental sustainability in Tanzania. Therefore, the study will help address the research gap in the field of EM, adding to the existing body of literature concerning environmental management in ASM.

Relevance to Social Change: The research findings will be useful in effecting positive social change in the lives of individuals and the local communities around the mining areas in the Geita region and in Tanzania. Positive social change is possible as the study will include collecting data that may help address environmental management problems that are known to hinder the effect of EM and thus cause health problems and other social issues. The research results will also reveal the areas to address to make a positive difference in the affected communities. The development and adoption of environmental sustainability practices will contribute to environmental protection and sustain life for the present and future generations.

1.6 Organization of the Dissertation

The dissertation is divided into five chapters. This chapter is the introductory chapter, which outlines the background of the study, statement of the problem,

research objectives, research questions, and the study's relevance. Chapter Two critically reviews the relevant theories and empirical literature relating to environmental management practices. Chapter Three provides an account of the study's methodology used to identify the main challenges affecting environmental management in the ASM sub-sector in Tanzania. This includes the presentation of the research approach, data collection methods, data analysis methods, and the operationalization of the study. Chapter Four details detailed presentation of the results of the descriptive, and multiple analyses whereby findings are interpreted, and synthesized with regard to past studies and the study's theoretical model. Chapter Five provides conclusions and recommendations relating to the study findings. Apart from that, the appendices to this dissertation include research activities or schedule, work plan, estimated research budget, and research instruments.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Definitions

2.1.1 Artisanal and Small-Scale Mining

Artisanal and small-scale mining, or ASM, is a largely informal economic sub-sector that includes workers around the world who use basic tools to extract from the earth everything from gold and gemstones to vital metals such as cobalt, tin, tungsten and tantalum (Rwiza *et al*., 2023).

2.1.2 Environmental Management (EM) Practices

EM practices involve a whole system of environmental management. The system includes policies and laws relating to the environment, environmental literacy, environmental information, conservation, regulations relating to the environment and management of waste and harmful products. In addition, EM is also referred to as clean production, pollution mitigation, environmental research, impact assessments and mitigation of negative impacts caused by mining activities (Kragt & Manero, 2021).

2.1.3 Stakeholder Engagement

"Stakeholder engagement" is defined as an ongoing, wider and all-encompassing practice between two parties. These are artisanal and small-scale miners and individuals potentially affected by the mining activities. This includes a variety of activities and organisms that will be negatively affected (Kragt & Manero, 2021).

2.2 Theoretical Analysis

Whereas many new theories have evolved regarding environmental management practices, the most popular theory is the stakeholder theory. The main theme of the stakeholder perspective focuses on the entity’s decision-making in business environments. The evolution of environmental management started in 1960, but the concept of environmental management became more aggressive from 1990 onwards.

2.2.1 The Stakeholder Theory

Pioneered by Freeman (1984), the stakeholder theory is an approach where the emphasis is on the need for organizational leaders to serve the interests of shareholders and also consider a range of benefits for the other stakeholders. Accordingly, stakeholder theory involves considering individuals or groups of people who can affect an organization and how organizational leaders respond to such individuals or groups (Tackie, 2020). Stakeholder theory thus reinforces the significance of creating value for different stakeholders for an organization's success.

Gutterman (2023) identifies three distinct but interrelated aspects of stakeholder theory. First, the normative aspect of the theory is used to interpret the corporation's function, including the identification of moral or philosophical guidelines for the operation and management of corporations. The second is the descriptive aspect of the theory used to describe and sometimes to explain specific corporate behavior and characteristics. The third is the instrumental aspect of the theory that seeks to establish the connection or lack of connection between stakeholder management and the achievement of traditional corporate objectives.

The moral perceptive of the stakeholder theory argues that individuals affected by the company's actions are rightful required to obtain the right information and to expect a certain level of company's responsibility in its actions towards the environment. Although mining operations require mining licenses, it is equally important to secure social license as well. This is important because stakeholders have the right to take legal actions against the company, which may lead to implicit and explicit costs. Social license is extensively applicable and has been impliedly accepted to operate as a Social License to Operate (SLO). This indicates great efforts made by policymakers and other development partners to protect the public and the environment globally. SLO refers to the ongoing acceptance of a company or industry's standard business practices and operating procedures by all stakeholders, including its employees and the general public (Oliveira & Rabechini, 2023). The company-community dialogue contributes to building relationships and leads to social acceptance of mining developments.

Increasingly, managers have also recognized that involving stakeholders in decision-making not only helps create value for sustainability but also for the simple reason that it is ethically right to do so. As Freeman (1994, p.2) said, "managing stakeholder relationships is non-optional; it is morally required." Consequently, "…involving stakeholders in analyzing problems and identifying solutions increases the chance of implementation and beneficial impact" (Gutterman, 2023).

Societal expectations about the environmental, social, and cultural 'performance' of industries involved in developing, using or managing natural resources have changed

over recent decades. Communities have increased expectations regarding the benefits they receive from the presence of such industries, along with assurances that the industry is properly regulated. Generating trust in the mining industry and its operators is an important driver of social acceptance in mining.

Organizational leaders could acquire some knowledge of their shareholders and other stakeholders to manage the different groups effectively. According to Menezes (2022), stakeholders measure the overall satisfaction of an organization from different dimensions, including an organization's environmental performance, financial returns, and perceived impact on the community or environment. Consequently, organizational leaders who balance the concerns of their different stakeholders in the decision-making process may also be more prepared to address long-term reputation problems than those who focus on attaining short-term returns on investments (Menezes, 2022).

Organizational strategies could thus include the aspects relating to environmental protection and obtaining economic gains while protecting the interests of the local communities and other stakeholders. Investments in environmental protection depend on many factors within most organizations. Some organizational leaders believe that the economic benefits that support profitability determine the legitimacy of investing in environmental preservation practices (Gutterman, 2023). Organizational leaders may invest in environmental responsibility if they believe that the investment will create more wealth for the shareholders. They tend to avoid investments when there is a financial risk in attaining a sustainable future (Oliveira, 2023).

In contrast, Goodpaster (1991) criticized the stakeholder theory for creating a ‘stakeholder paradox’, as it fails to distinguish between the fiduciary responsibilities managers have to stockholders and the non-fiduciary responsibilities they have to other stakeholders. In response, Freeman (1994) argued that a criticism like Goodpaster's is based on a faulty premise, which he termed the ‘separation thesis.’ Freeman (1994) noted that Goodpaster (1991), like most other critics, fails to recognize that the stakeholder theory was a class of theories and not just one theory in opposition to the stockholder theory (*see also* Jones & Wick, 1999). As Freeman (1994, p.2) said, “managing stakeholder relationships is non-optional; it is morally required.” Consequently, involving stakeholders in analysing problems and identifying solutions increases the chance of implementation and beneficial impact.

The stakeholder theory is applied in this study to understand the problem of cooperation between the diverse actors or partners within Tanzanian’s ASM sub-sector and how they respond to environmental management issues. The company’s stakeholders are considered when the company’s stakeholders' genuine interests are considered when making company decisions. Consequently, this will increase the firm's legitimacy in the public eye. Empirical and theoretical frameworks have provided evidence of this proposition, which has created the urge and need to incorporate stakeholders further in decision-making for the effective adoption of EM practices (Gutterman, 2023).

2.3 Empirical Analysis of Relevant Studies

2.3.1 Challenges facing Environmental Management Practices in Artisanal and Small-Scale Mining (ASM)

The ASM sub-sector is a central driver of economic growth in developing countries (Kragt & Manero, 2021). However, various activities of the artisanal and small – scale miners contribute significantly to environmental degradation (Mestanza-Ramón *et al*., 2022). The problem is reflected in various offsite, onsite and operational activities, resulting in all kinds of environmental pollution. These negative environmental impacts pose a challenge to the well-being of humans (Kragt & Manero, 2021). This, therefore, necessitated the call for improvement of environmental performance by artisanal and small–scale miners. The consciousness of inimical effects of various activities on the environment led to the proposition of Environmental Management practices (Moonsammy, 2021). Nonetheless, the implementation of EM practices has not been effective due to several challenges.

In developing countries, the problems associated with the non-implementation of EM practices remain obvious, and addressing the issue is equally important (Tuokuu *et al.,* 2019). Research on identifying challenges affecting EM implementation is rare, and existing studies have come up with inconsistent results.

For example, Jha *et al.* (2023) sought to develop a framework to identify, analyse, and assess the mining industry's key challenges in terms of environmental management in the Indian mining sector. Fifteen (15) challenges were identified from experts' opinions and the relevant literature; each is examined in a real-world industrial setting. A fuzzy Decision-Making Trial and Evaluation Laboratory

(DEMATEL) was used to assess and rank the challenges. Results reveal that climate change, lack of availability of capital, and fair wages are the top challenges in the EM in India's mining industry.

Mabrouk and Ibrahim (2021) conducted a study to determine the challenges in the implementation of EM in Tunisia. This was achieved by reviewing literature and expert opinions, whereby 14 critical challenges were identified in EM in the Tunisian context. The study found that “Top management commitment and support” and “Government policies and legislation” were the most significant challenges in EM implementation in Tunisia.

Ojo *et al.* (2021) investigated challenges affecting environment management in Nigeria. The researcher adopted a descriptive research design, particularly a survey to determine the relationship between variables. A questionnaire was used to collect data from 106 purposively selected respondents. The study used descriptive, univariate and multivariate analyses. Findings showed that environmental management is affected by knowledge, process, and culture and management challenges.

Kinyondo and Huggins (2021) examined the current regulatory and institutional capacity for environmental management in Tanzania. Their findings indicate that the regulatory and institutional context provides opportunities for improved environmental management. Still, there are major obstacles include poor interagency coordination and insufficient capacity. Moreover, central government agencies'

emphasis on state revenue collection and macro-economic development overshadows other considerations, including environmental protection. Similarly, Kinyondo and Huggins (2020) carried out another study to examine whether the formalization of the artisanal and small-scale mining sub-sector has any effect on environmental management. Using documents, reviews, and interviews with key informants, the study suggests that there is generally no automatic connection between the formalization of artisanal and small-scale mining and the improvement of environmental management in Tanzania. Kinyondo and Huggins (2020) found that the main challenges include lack of funding, limited capacity, poor coordination, the nomadic nature of artisanal and small-scale mining operations, and using formalization as a revenue-increasing tool.

Rivera-Acosta and Martinez-Torres (2019) aimed to assess the main environmental challenges faced by mining companies in Mexico to contribute as a sector-oriented towards sustainability. The research method used in the study was qualitative, including documentary research and the analysis of different sources of information through reading and reflection. The major challenges to effective EM implementation in the Mexican mining sector were weak regulatory framework and lack of technical knowledge by miners, particularly small miners.

Using both primary research and a review of secondary data, Mutagwaba *et al.* (2018), examined challenges affecting the ASM in Tanzania. The research adopted a multi-method approach for effective data collection. This included a desktop study, stakeholder mapping, and stakeholder engagement using semi-structured interviews,

key informant interviews and site visits in selected locations. Mutagwaba *et al.* (2018) found that it has proven challenging for Tanzania's government and other organizations in environmental management in ASM. They found that there are many reasons for this, including insufficient funding for various organizations, which often translates into limited capacity; coordination between state agencies is at times problematic; informal (and often seasonal) nature of mining work, which often takes place in remote rural areas, making it difficult for authorities to communicate with artisanal miners regularly.

Waxin, Knuteson and Bartholomew (2017) examined key challenges related to EM in the United Arab Emirates, an emerging Arab country, and compared and contrasted these challenges between private and public organizations. The study adopted an explorative, qualitative methodology, using semi-structured interviews with environmental managers in 11 organizations (6 private and 5 public) from different industrial sectors. The challenges to EM implementation were similar for private and public organizations. They were a lack of qualified human resources, practical challenges associated with implementation, a lack of regulations, support from management, and high costs.

Owalana and Booth (2016) conducted a study to investigate stakeholder opinions of the major challenges of environmental management in Nigeria and the perceived issues related to EM adoption among organisations. The research adopted a quantitative approach by analysing responses from an online survey among respondents in Nigeria. The questions on the survey were drawn from a similar study

carried out in Asia, and the results were analysed using the Weighted Average and standard Deviation statistical approach. Lack of technological support in organisations and the high cost of implementing EM practices are viewed as the major challenges to effective EM.

2.3.2 The Level of Environmental Management Compliance and Practices in Artisanal and Small-Scale Mining (ASM)

The effect of the mining activities of the artisanal and small-scale miners on the environment is distressing. This amounts to a negative impact on these miners' livelihood and the general public. Development partners and policy makers saw the need to institute an Environmental Management practice to deal with this threat. Issues relating to Environmental Management practices in developed nations have been extensively narrated (Mabrouk and Ibrahim, 2021). In addition, the potential benefits derived from adopting EM practices by these developed countries have been explained by many authors, such as (Tuokuu *et al.,* 2019). Nevertheless, studies on the relevance and adoption of EM practices in Third World countries are inadequate. This includes research relating to adopting of EM practices by artisanal and small–scale miners in Third World countries (Ojo *et al*., 2021).

For instance, Bambuch (2023) sought to analyse the extent of implementation of environmental management in the Brazilian mining sector. The study used a descriptive survey method whereby 3 mining companies in Minas Gerais were purposively selected. The questionnaire and the checklist for EM practices were used as the main research instruments for data collection. The study's findings showed

that mining companies in Brazil have a low level of environmental management practices, whereby the sample companies' level of EM implantation stood at 46%, 56% and 8%. Moreover, results suggest that 2 out of the 3 sampled firms use a reactive method when implementing EM. In contrast, the remaining firm is pro-active when dealing with environmental issues and EM implementation.

Mutuku (2021) carried out a study to examine the status of EM practices in Kenya using cases of Nakuru, Nairobi, Kisumu, Mombasa, Kitale, Machakos, Thika, Kericho, Naivasha and Eldoret. The study used a descriptive design and a quantitative approach. The targeted population of the study involved 30 companies in respective regions. Sampling methods used in the study were stratified and simple random sampling whereby the sample was divided into 3 strata: agriculture, manufacturing and service industry. Results showed that the average extent of EM implementation was 32%. The study recommended that to enhance good environmental quality, enforcement of applicable legislation should be combined with education on voluntary EM, a new area of strategies for EM in Least Developed Countries (LDCs).

Mbewe (2017) sought to examine stakeholders' perceptions regarding adopting the environmental policies in the Zambian mining sector in Copper Belt Province. A descriptive research design was used whereby a qualitative approach was adopted for data analysis. Data were collected using semi-structured interviews with 24 respondents in a copper mining company who were purposively selected. Data analysis involved thematic analysis. The results of the study revealed that the

company does not have environmental management practices and that its activities are harmful to the environment. This was caused by a lack of technical know-how, lack of Information Technology (IT) and lack of CSR. Thus, the study made the following recommendations: community engagement in EM, conducting advocacy campaigns on the importance of environmental management, seeking more support from the government, improving the environmental legal framework, and instituting Information Technology. Moreover, stakeholder engagement in the EM should be promoted to ensure sustainable development.

Makondo *et al.* (2017) assessed the adoption of EM practices in the Zambian extractive sector. Moreover, the study intended to assess the commitment of the Zambian government towards environmental conservation to achieve sustainable development. To achieve the main goals of the research, the authors reviewed environmental indicators at the industry level vs. actual environmental management implementation. Data were analyzed for 6 years from 2009-2014, during which the development of the environmental policy was tracked, and how it was implemented in the extractive industry. The authors concluded that Zambia has a strong legal framework for environmental conservation, which was established in 1970 by adopting the English policy framework. Nevertheless, compared to the environmental legal framework for developed countries, the Zambian framework is still new with many challenges. These challenges include a lack of coordination between government departments relating to environmental management and weak institutions for Environmental Impact Assessments (EIA), thus affecting environmental conservation.

2.3.3 A Framework for Stakeholders' Engagement in Environmental Management in Artisanal and Small-Scale Mining (ASM)

Over a few decades, there has been an increased interest in participation in environmental decision-making. Individuals will be interested in the EM for their self-interest and for the sake of environmental conservation (Rwiza *et al*., 2023). Decision-making relating to the environment has been different in recent years to consider the environmental impact on human beings, which is intentional (Mutagwaba, 2018). Involving stakeholders in EM decision-making is regarded as crucial for its success. In addition, stakeholders' engagement in EM is also very useful in obtaining sufficient and practical evidence on what really works and the challenges are when involving stakeholders in the EM programmes of the entity. The main goal of stakeholder engagement in the EM is to improve the quality of EM.

Due to more concerns about EM issues, which are quite complex, it is vital that practitioners and researchers design best practices for engaging stakeholders in the EM. The forum should thus create a toolbox for activities relating to stakeholders' engagement while at the same time proposing appropriate methods that will be valuable for reviewing and mapping stakeholders' engagement in EM.

Many authors have assessed different approaches that can be used to engage stakeholders of EM programmes. For instance, Haddaway *et al.* (2017) state that the best approach to incorporating stakeholders in the EM should involve structuring a system with inputs such as environment policies and processes and outputs such as decisions. To successfully implement such a system, stakeholders need to be identified, characterized and organized. This will enable stakeholders to obtain a

specified level of participation and, hence appreciate their differences and heterogeneity. Participating methods should be selected based on the level of participation of each stakeholder. Moreover, evaluation is the necessary step to be conducted once the whole process is complete.

Talley *et al*. (2016) evaluated complicated frameworks relating to the involvement of stakeholders in the EM into 5 main principles to be used by experts in natural resources for planning stakeholders' participation in the EM. Although development partners and policy makers appreciate the important benefits of engaging stakeholders in the complicated environmental management process, the process of engaging these stakeholders varies significantly from one entity to another. This signifies the existence of huge differences in the approaches and frameworks used. Since there are several different methods of engaging stakeholders in natural resources management, it is thus important to understand that both conceptual and theoretical frameworks for their engagements are vibrant. To date, the authors analyzed the main components of stakeholder engagements to design the five-feature stakeholder engagement framework (e.g. Haddaway *et al.*, 2017). This framework has helped access a practicable and user-friendly forum for consideration of the involvement of stakeholders. Apart from developing the five-feature stakeholder engagement framework, the authors also used this framework as a benchmark for assessing practical cases relating to the engagement of stakeholders in the environmental management programmes (e.g. Mutagwaba, 2018). This is important as it helps in understanding challenges that exist or may come up during the implementation process of the stakeholder engagement framework. Results of the

study imply that the most important values needed in the stakeholder engagement process are usually overlooked during stakeholder engagement in the EM programmes. This signals that a practical and functioning framework for stakeholder engagement is required.

Fikkert (2020) examined the engagement of stakeholders and how entities can incorporate environmental sustainability. The study used a qualitative approach, using an interview for data collection. Data were analyzed thematically after being properly coded and cleaned. The study's findings revealed that there are 5 important factors that could potentially influence environmental sustainability. Moreover, findings showed that direct stakeholdersdirect stakeholders can significantly enhance the entity's incorporation of environmental sustainability. Fikkert (2020) argues that if the entity embraces direct stakeholders at all levels of the entity, it can guarantee integration of the sustainability concept, whereby the concept will take more effect with time, eventually leading to institutionalization. Second is the increasing demand for transparency; the wide array of stakeholders that the organization engages with initially forms a challenge when it comes to transparency. However, this transparency indirectly contributed to the integration of sustainability using, new knowledge demands. In the higher levels of the organization, a higher risk was perceived about transparency, the author argues, due to engagement with a larger number of mainly societal stakeholders. Fikkert (2020) further argues that interactions with other organizations have shown to be necessary to move towards a more sustainability-oriented state. Classifying stakeholders in three broad categories has helped to obtain a new perspective on how entities involve different categories

and types of stakeholders to ensure sustainability in environmental management. While direct stakeholders have been engaged for cooperative purposes in different aspects of business, societal stakeholders are usually involved in creating KPIs. Utilising societal stakeholders is helpful to the entity because the entity can assign a meaning to KPIs that goes beyond the boundaries of an entity to the public.

Aalderen *et al.* (2023) carried out an analysis aimed at contributing to the understanding of integrated management of assets by elucidating the usually implied concerns regarding the engagement of stakeholders. The provision of a conceptual framework was used to explore and analyse 3 cases relating to the management of assets. The study provides a framework for stakeholder engagement while being directed by time, mission, and the local framework. By considering the normal schedule of asset supervisors as an illustration, the authors synthesize the relationship between stakeholder engagement and asset management. This helps to illustrate that both relational considerations and material should be made deliberately in all phases of an asset management project.

Aryee (2014) examined Ghana's mining industry against environmental governance frameworks such as co-management, stakeholder consultations, and collaborative environmental governance. This research employed a case study approach, the analysis and evaluation of secondary data, and a face-to-face interview with some miners. The researcher concluded that in Ghana, stakeholders tend to focus on their interests at the expense of environmental conservation in the mining communities.

Therefore, if relevant stakeholders are empowered, the country will take advantage of gold mining while ensuring environmental sustainability in the long run.

2.4 Research Gap

Several empirical studies, such as (Kragt and Manero, 2021 Mabrouk and Ibrahim, 2021 and Ojo, Oladinrin and Obi, 2021), have been carried out to investigate environmental management challenges, as shown above. Nonetheless, environmental management challenges are a discussion that still brings disagreement among scholars in the field. Most of these studies have produced conflicting results and conclusions, with differences in areas of the study, methodology used, theories adopted, and variables used.

For example, while Marimuthu *et al*. (2021) revealed that climate change, lack of availability of capital, and fair wages are the top challenges in the EM in India's mining industry, Rivera-Acosta and Martinez-Torres (2019) concluded that policy challenges are critical in hindering EM in the mining industry in Mexico. These inconsistencies suggest that the association between critical challenges and environmental management is inconclusive.

Several studies have been conducted in Tanzania to analyse environmental management challenges (e.g. Mutagwaba *et al*., 2018; Kinyondo and Huggins, 2021; and Mwakaje, 2012). However, none of them has explicitly evaluated and quantified the net effect of different categories of challenges on environmental management for artisanal and small–scale miners, who form the majority of miners in Tanzania. This

implies that existing literature in Tanzania has yet to traverse environmental management challenges. The current study intends to fill in the identified gap by examining which challenges are critical to EM in the ASM in Tanzania.

2.5 Conceptual Framework

In this subsection, a conceptual framework that represents the relationship between study variables relating to the assessment of improving environmental management practices and the associated challenges in the ASM is depicted in Figure 2.1. Such a study has not been conducted in Tanzania. The study intends to (i) identify challenges affecting environmental management practices in Artisanal and Small Scale Mining (ASM), (ii) assess the level of environmental management compliance and practices in Artisanal and Small Scale Mining (ASM), and (iii) to propose a framework for stakeholders' engagement in environmental management practices in Artisanal and Small Scale Mining (ASM).

Similar to Kinyondo and Huggins (2021), challenges that affect the performance of ASM were lack of awareness, difficulty with environment issues, lack of specialists, lack of EM knowledge, lack of leading initiatives, complex documentation process, high cost of EM implementation, negative attitude of artisanal and small–scale miners, ambiguity in legal interpretations, multi-layered sub-contracting, limited stakeholders' pressure, resistance to training and lack of EM training and education. The main assumption is that these challenges hinder the implementation of EM practices, which are measured as environmental policy, environmental affairs within budget; the environmental responsibilities fixed; there is an environmental record in

our mining site; consideration of potential sources of pollution; easy identification of environmental impact; annual waste declaration are mandatory; Environmental focused training; Periodic revision of environmental policies; Environmentally sustainable practices; procedural practices adopted and Environmental Impact Assessments. Therefore, the proposed framework for stakeholders' engagement is expected to be the main solution for improving EM practices, as shown in Figure 2.1.

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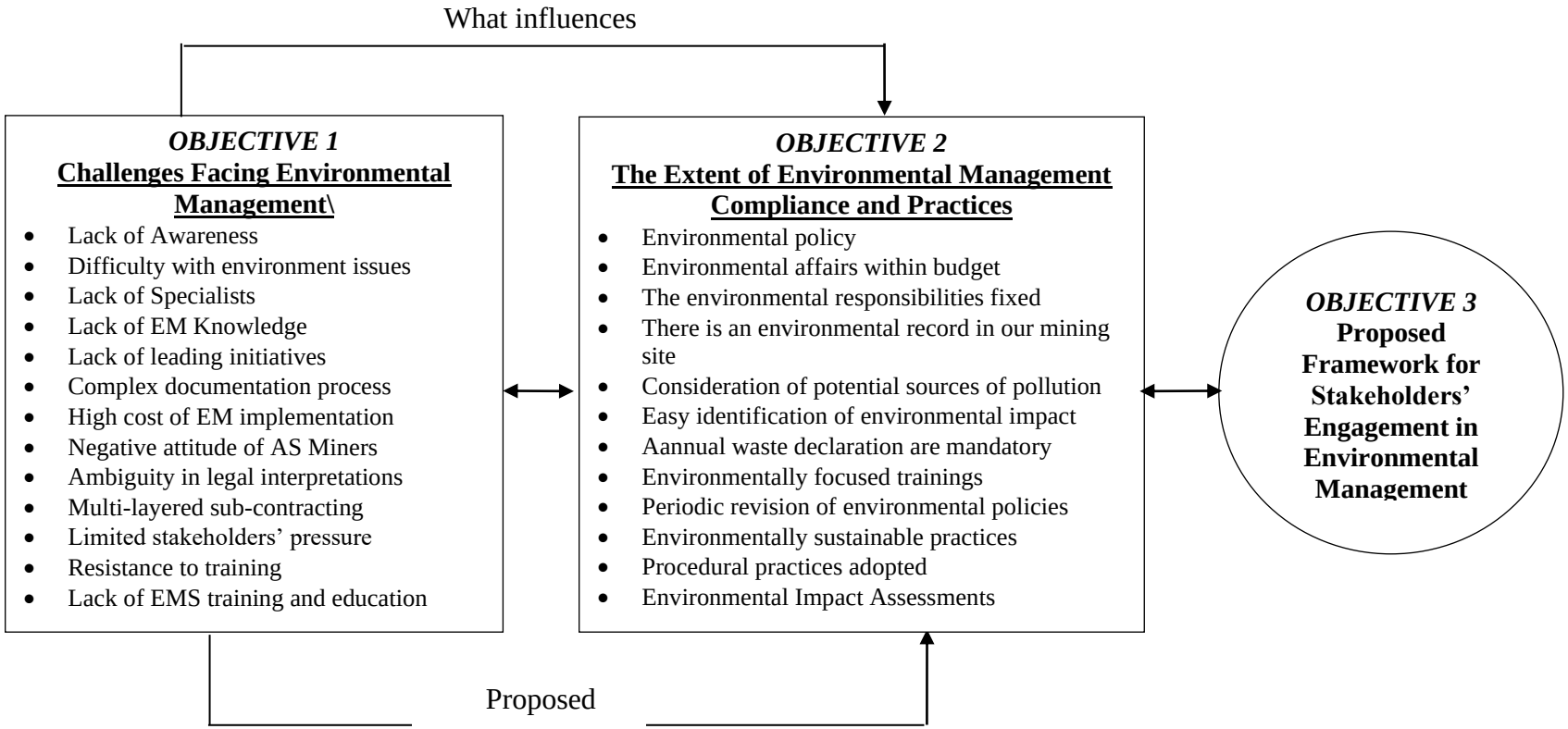

Figure 2.1: Conceptual framework

CHAPTER THREE

RESEARCH METHODS

3.1 Research Strategies

3.1.1 Research Design

A research design entails a process to collect, analyse, interpret and report data in study/research (Panya & Nyarwath, 2022). This study adapted descriptive research design; specifically, survey method was used where the participants were required to answer questions administered through questionnaires and interviews. After getting the answers from the participants, researcher described the responses given. The major purpose of descriptive research design is to describe the state of affairs as it exists at present (Dawadi *et al*., 2023).

3.1.2 Research Approach

The researcher used both quantitative and qualitative research approaches in carrying out the study. The quantitative approach involves collecting and analysing numerical data (Saunders *et al.*, 2016). It is a highly detailed and structured approach which allows results to be collated and presented statistically. On the other hand, qualitative approach tries to capture reality interaction (Dawadi *et al*., 2023). The information required for the study was collected by using questionnaires and interviews and which were given to the individuals who were selected as the sample, to represent the intended population.

3.1.3 Survey Population

The target population that formed the units of analysis for this study comprised of the

entire population of Mbogwe District comprise of 362,855 individuals. Apart from that, this study targeted 20 stakeholders involved in the ASM sub-sector in Tanzania. These include mining commission offices; NEMC officers, regional officers from Tanzania Mining Commission, STAMICO offices and officers from the private sector such as TCCIA. These stakeholders were more relevant in a qualitative analysis. Generally, the researcher targeted respondents who had the ability to provide reliable and relevant information that helped to achieve the study's objectives.

3.1.4 Area of the Study

This study was conducted in Nyakafulu Gold Rush, in Mbogwe district, Geita region, Tanzania. Mbogwe District (with coordinates 03°22′S 032°9′E) is one of the five districts of Geita Region of Tanzania. It is bordered to the north by Chato District and Geita District, to the east by Kahama Rural District and Kahama Urban District, to the south by Kahama Rural District, and to the west by Bukombe District. Mbogwe District was selected for this study because is one of the districts in Tanzania badly affected by mining activities of AS mining. Irresponsible use mercury ASM has caused some serious ecological problems in Mbogwe District. For example, according to Pancrace (2022), the degradation of the Bukombe-Mbogwe Forest Reserve (BMFR) has been exacerbated by the presence of ASGM activities within the Mbogwe District whereby empirical evidence shows that ASGM has negatively changed vegetation cover in BMFR and surrounding villages. This phenomenon has caused a noticeable decline in the diversity of tree species within the forest reserve.

The Municipality has a total population of 362,855 whereby males are 179,157 and females are 183,698 (NBS, 2022). Agriculture is the major economic activity in the municipality. Other economic activities are industry and commerce. Based Mbogwe District's Profile issued by Mbogwe Local Council-Planning Department, about 75 percent of the economically active population are engaged in the agricultural sector whilst the remaining 25 percent are engaged in the area of commerce and industry. The highest income earners in the Municipality are miners followed by construction and consultancy firms respectively in the Municipality. The labour force in the agricultural sector has been decreasing due to the fact that people find ASM more lucrative.

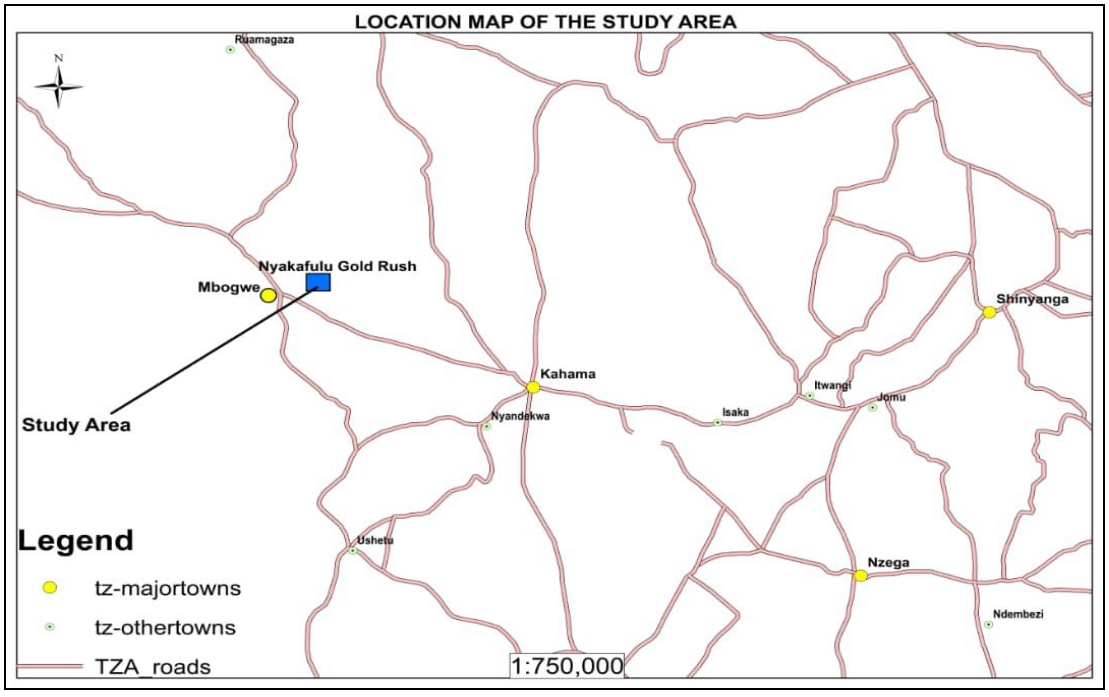

Figure 2.2: Location Map of Nyakafulu Gold Rush in Mbogwe District

3.2 Sampling Procedures

For a quantitative approach, out of the targeted 362,855 people stakeholders from the study's sampling frame, Yamane's formula (1967) was used to determine the sample

size of the study. A Yamane formula was ideal because the targeted population is finite and known. The sample size was calculated as shown below:

$$n = \frac{N}{1 + N\ (e)\text{^}2}$$

Where, n=sample size N= population size e= the margin error

Therefore, under this study N=362,855, e=10%.

$$n = \frac{362{,}855}{1 + 362{,}855(0.1)\text{^}2} = 100$$

Thus, the sample size obtained was 100 respondents, which was considered optimum for achieving the study's purpose and objectives. After obtaining a sample size, a simple random technique was used to select respondents from the population. This method gave each respondent an equal chance of being selected, thus enhancing the representativeness of the study's findings. Apart from that, purposive sampling was used to obtain a sample size for the qualitative approach. A total of 20 stakeholders were selected purposively, and the study targeted the richest members of the information.

3.3 Data Collection Procedures

3.3.1 Primary Data

Quantitative data to analyse the main challenges affecting environmental management in the ASM sub-sector in Tanzania were obtained through a self-administered questionnaire. Like Ojo et al. (2021), the questionnaire was close-ended based on a 10-likert scale aimed at enhancing understandability, reducing confusion

in reading and answering a questionnaire for the respondents. Moreover, the questionnaires in this study enhanced objectivity because questionnaires are less affected by personal influences.

The questionnaires consisted of 30 questions. Before the data collection process, the questionnaires were tested for reliability using Cronbach's Alpha during a pilot study. The pilot survey involved 25 participants (not otherwise included in the study sample). The questionnaire had 5 sections carefully designed to fulfil the study's research objectives. The first section required respondents to fill in their demographic information, and 8 questions were included in the first section. The second section of the questionnaire required respondents to respond to questions relating to challenges affecting EM in the ASM sub-sector. In total 13 questions were included in this section. Section 3 contained 9 questions that were intended to examine environmental management issues. Section 4 explored issues relating to stakeholders' engagement, while Section 5 contained general questions relating to recommendations for improvements.

In addition, qualitative data were collected through Key Informant Interviews (KIIs) and in-depth face-to-face semi-structured interviews with individuals wholly or marginally attached to artisanal and small–scale miners. These involved targeted stakeholders such as District and regional mining officers, NEMC officers, regional officers from Tanzania Mining Commission, regional officers from STAMMICO and officers from the private sector such as TCCIA.

3.3.2 Secondary Data

Secondary data were collected through documentary review, which helped compliment the primary data collected. Different documents, reports, literature and past studies on EM practices in the ASM sub-sector were reviewed and analyzed. Secondary data included data that were already available and which had already been collected and analyzed, for example, data from Municipal Statistics, the Geological Survey of Tanzania (GST), Zonal Mines Offices in the study area, Regional and District government records, National Environment Management Council (NEMC), Regional miners' associations (REMAs) in the selected project area, and the Federation of Miners Associations Tanzania (FEMATA). The study further utilized a documentary review to analyze documents related to the topic under study. This study critically reviewed official documents such as brochures and programme guidelines on mineral sector and ASM to understand environmental challenges among ASM in the Nyakafulu Gold Rush.

3.4 Data Processing and Analysis

To analyse objective One: *to identify challenges affecting environmental management in the ASM sub-sector in Tanzania*, this study employed a quantitative data analysis method. First, descriptive data analysis was performed, and frequencies, means, percentages, and standard deviations were produced and summarized in tables to facilitate understanding and interpretation. Second, a multivariate regression method was used to determine environmental management challenges. An OLS regression model was employed, which was ideal for this study because the dependent variable was continuous.

According to Saunders *et al.* (2016), multiple linear regression assumptions include Linearity, Normality, Multicollinearity, Autocorrelation and Homoscedasticity. Thus, normality was tested through Shapiro –Wilk. Multicollinearity was tested using variance inflation factors. Heteroskedasticity was tested through the Breuch-Pagan test. Autocorrelation was tested through the Durbin-Watson statistic. Stationarity was tested using the Levin-Lin-Chu test. Linearity was checked by examining the residual scatter plots. The log transformation process was used to transform data where OLS assumptions were unmet.

Moreover, the method for including variables in the model was done stepwise in the future, testing for the significance of the inclusion of the variable at every stage. Adding more variables stopped when all of the variables had been included. The variables used are defined and measured as per Table 3.1.

Table 3.1: Operationalization of variables and measurement

No	Code	Variable description	Measurement
1.	EM	Environmental Management	Mean score
2.	AWARE	Lack of awareness of EM	10-Likert scale
3.	ENVIRON	Difficulty with environmental issues	10-Likert scale
4.	SPECIALIST	Lack of specialist on EM	10-Likert scale
5.	KNOWLEDGE	Lack of knowledge on EM	10-Likert scale
6.	INITIATIVE	Lack of leading initiatives	10-Likert scale
7.	COMPLEX	Complex documentation process	10-Likert scale
8.	COST	High cost of EM implementation	10-Likert scale
9.	ATTITUDE	Negative attitude of AS miners	10-Likert scale
10.	AMBIGUITY	Ambiguity of interpretation of EM Laws and regulations	10-Likert scale
11.	CONTRACT	Multi-layered sub-contracting	10-Likert scale
12.	STAKE	Limited stakeholders' pressure	10-Likert scale
13.	RESIST	Resistance to training by AS miners	10-Likert scale
14.	TRAIN	Lack of EM training and education	10-Likert scale

Source: Researcher, 2024

To analyse objective Two: *the extent of environmental management compliance and practices in Artisanal and Small-Scale Mining (*ASM*),* this study employed a quantitative data analysis method. Specifically, descriptive data analysis will be performed, and frequencies, means, percentages and standard deviations will be produced and summarized in tables to ease understanding and interpretation.

To analyse objective Three: proposing a framework for stakeholders' engagement in environmental management in Artisanal and Small-Scale Mining (ASM); the study focused on extracting meaning from the interviews analyzed through thematic analysis. The thematic analysis refers to an analytical approach involving examining discussions to establish meanings and intentions (Panya *et al*., 2023). It also refers to qualitative content analysis used in construction research (Panya *et al*., 2023). The opinions of the interviewees were analysed and interpreted to derive principles and practices of stakeholder engagement.

The main theme involved approaches employed in stakeholder engagement practices in EM. Then, the extracted practices (sub-themes) were applied to the rest of the data to see if there was a similar occurrence both implicitly and explicitly. This was applied carefully to capture all other sub-themes that could emerge from the rest of the interviews.

3.5 Ethical Considerations

Several ethical issues were considered in this research. First, permission to collect data from 350 respondents at the Nyakafulu gold rush in the Mbogwe district in

Geita region was sought. The process of seeking research permission included obtaining an introduction letter from the Open University of Tanzania to allow the data collection process.

During data collection, respondents were provided with the consent form, and informed them on the objective of the research and assured their confidentiality and that the information sought from them was strictly for academic purposes. Other research issues considered in this research included avoiding plagiarism, consideration of contrary data, consistent use of statistical methods, and the use of data from previous research. In addition, the study used original data from the field and no data were fabricated**.**

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Rate of Response from Surveyed Individuals

The response rate of a survey, which is the percentage of people invited to the survey who actually completed the questionnaires meaningfully, provides an indication of how respondents perceive the study to be beneficial to them (Mhlanga & Denhere, 2020). The researcher collected data at Nyakafulu gold rush in Mbogwe district in Geita region using traditional face-to-face administered questionnaires to a sample of 100 respondents consisting of AS miners. Since snow ball method was used to replace respondents who were not available, the researchers managed to collect data to a total of 100 respondents as intended; representing 100% response rate (See Table 2 above). In comparison to similar studies, Ojo *et al.* (2021) and Olalekan (2017) had response rates of 88%, and 75% respectively.

Table 4.1: Response rate

Questionnaire	Frequency	Percentage
Response	**100**	**100%**
Non-response	0.0	0.0%
Total	100	100%

Source: Field data (2024)

The higher the response rate the more minimal the non-response bias. Non-response bias implies the error resulting from distinct differences between respondents to a survey and those who did not respond (Fosnacht, *et al*., 2017). Renowned researchers such as Kothari and Garg (2014) provide categorizes response rates as adequate (i.e.50%); good (i.e. 60%-69%); excellent (i.e. 70% to 100%). Based on this

categorization, the study's overall response rate of 100% was considered excellent and suitable for analysis and presentation of the study's findings.

This high response rate is also attributed to good logistical preparations prior to and during the field work by the research team, which enhanced social acceptability of the enumerators by potential respondents and facilitated their movement in the study sites. From both overt and covert field observations, this study was of remarkable relevance to the respondents. As such, it aroused much interest and expectations among many potential respondents to participate in the study.

4.2 Results of the Reliability Tests

The researcher computed Cronbach's Alphas for the constructs of the study in order to test the reliability of the questionnaire that was used to collect data. Reliability tests were performed during a pilot study that was done from 12th February, 2024 to 14th February, 2024 to 25 relevant individuals (not otherwise included in the study sample). The results of the Cronbach's Alpha for each study construct as well as for the general questionnaire are provided in Table 3 below.

Table 4.2: Results of reliability tests

Constructs	Cronbach's Alpha	Number of Respondents	Number of Test Items	Comment
Demographic factors	0.872	25	5	Reliable
barriers affecting environmental management	0.852	25	13	Reliable
Environmental management compliance and practices	0.819	25	7	Reliable
framework for stakeholders' engagement	0.788	25	7	Reliable
Overall reliability	0.811	25	34	Reliable

Source, Field data (2024)

Table 3 above provides results of the reliability tests on study's main constructs. These were: demographic characteristics (Cronbach's Alpha = 0.872); barriers affecting environmental management (Cronbach's Alpha = 0.852); Environmental management compliance and practices (Cronbach's Alpha = 0.819); and framework for stakeholders' engagement (Cronbach's Alpha = 0.788). In addition to that, results show that the overall Cronbach's Alpha for the study's constructs is 0.811. Generally, reliability tests signify that the data collection instrument was reliable.

According to Jugessur (2022), the data collection instrument is reliable when the Cronbach's Alpha coefficient is at least 0.7 and above. In the study of Ojo et al. (2021), results of the reliability test produced an overall Cronbach's Alpha correlation coefficient of 0.891 while specific findings indicated barriers affecting EM and environmental management compliance practices each had a coefficient of 0.822 while framework for stakeholders' engagement had a coefficient of 0.818.

4.3 Demographic Characteristics of Respondents

The study analysed demographic characteristics of the 100 respondents from the area of study. These include gender, age, education level, and income level. Descriptive statistics of the respondents' demographic characteristics are presented below as follows:

4.3.1 Distribution of Respondents by Gender

The study analysed respondents by gender as shown in Table 4 below. Gender distribution is an important socio-cultural construct that brings to fore the differences

in roles, functions, entitlements and deprivation of men and women. Findings reveal that more than 80% of respondents were males while female respondents constituted only 16% of all respondents. Although the study was not biased as it considered gender balance, however, the lower involvement of female respondents is consistent with the national demographic profile which shows that more men are more involved in AS mining than women. Women in Nyakafulu are involved in crush the ore into smaller fine particles, sort grade and wash them. Miners said that they spent six hours crushing the rock to get fist-sized pieces. Then they pass it on to female colleagues who sort and wash them in the river. Similarly, in the study of Owalana and Booth (2016), only 11% of respondents constituted females.

Table 4.3: Distribution of respondents by gender

Gender	Frequency	Percent
Male	84	84%
Female	16	16%
Total	**100**	**100%**

(Source: Field data, 2024)

In contrast, in her study, Bishagazi (2020) had the highest percentage of respondents being females (i.e. 88%) while males were 12%.

4.3.2 Distribution of Respondents by Age

The Findings from Table 5 indicate that 46% were aged between 18 and 30 years; while 42 respondents (i.e. 42%) were aged between 31 and 40 years. In addition, 2 respondents (i.e. 2%) were aged between 41 and 50 years while only 1 respondent (i.e. 1%) was aged between 51 and 60 years. In addition, there was no respondent

above 60 years. These results show that most of the AS miners in Nyakafulu in Geita District are mostly young people and school dropouts aged between 18 and 30 years most miners in Nyakafulu are youths and school dropouts in search of green pastures in mining. These findings are supported by those of Mabrouk and Ibrahim (2021) whose 60% of respondents were in age group of 18 to 30 years. In contrast, more than 60% of respondents in the studies of Ojo et al. (2021) were aged between 15 and 34 years. In addition, Owalana and Booth (2016) reported a mean age of 34 years for their respondents.

Table 4.4: Distribution of respondents by age

Age Bracket	Frequency	Percent
61 and above	0	0%
51-60	4	4%
41-50	8	8%
31-40	42	42%
18-30	46	46%
Total	**100**	**100%**

Source: Field data (2024)

4.3.3 Distribution of Respondents by Education Level

The analysis of the education characteristics of respondents (see Table 6 below) shows that most respondents (i.e. 46%) have a primary education level and 31% of respondents have a secondary level education. Moreover, 23% of respondents have university/college level education. Generally, these statistics imply that the level of formal education of respondents is very low whereby around 77% of them have secondary education or lower. Similarly, Bishagazi (2020) reported that 55% of their respondents had primary level education; 10% had secondary level education, 3% had tertiary education while 32% did not have any formal education.

Table 4.5: Distribution of respondents by education level

Education Level	Frequency	Percent
University or College and Above	23	23%
Secondary	31	31%
Primary or Less	46	46%
Total	**100**	**100%**

Source: Field data (2024)

From the descriptive statistics above, primary education is the modal level for most respondents. In Tanzania and in most developing countries, formal education is often perceived as a ladder towards white collar jobs because these jobs require particular levels of literacy or standards of education. Most Tanzanians have basic formal education or no education at all; there is minimal presence of AS miners as you progress up the education ladder (Mutagwaba *et al*., 2018). In Nyakafulu, respondents with university/college education are usually given supervisory role.

4.3.4 Distribution of Respondents by Income Level

The results of the descriptive statistics relating to income level presented in Table 7 above show that majority of the respondents (i.e. 44%) earn less between Tshs. 50,000 and Tshs. 300,000 per month. Apart from that, 25% of respondents earn between Tshs. 300,001 and Tshs. 500,000 per month while 20% of them earn less than Tshs. 50,000 per month. In addition, 8% of sampled AS miners earn between Tshs. 500,000 and Tshs. 1,000,000 per month while only 3% of the respondents earn income above Tshs. 1 million per month.

Table 4.6: Distribution of respondents by income level

Income Level	Frequency	Percent
Less than Tshs. 50, 000 per month	8	20%
Tshs. 50, 000- Tshs. 300, 000 per month	8	44%
Tshs. 300, 001- Tshs. 500, 000 per month	8	25%
Tshs. 500, 001- 1,000, 000 per month	38	08%
Above Tshs. 1, 000, 000 per month	38	03%
Total	**100**	**100%**

Source: Field data (2024

In the study of Mutagwaba *et al.* (2018), the results showed that majority of the respondents earn less than Tshs. 300,000 from ASM. Moreover, 40% of the respondents earned more than Tshs. 300,000 while only 10% of the respondents has AS income between Tshs. 500,000 and Tshs. 1,000,000.

4.3.5 Distribution of Respondents by Marital Status

Table 4.7: Distribution of respondents by marital status

Marital status	Frequency	Percent
Married	77	77%
Single	23	23%
Total	**100**	**100%**

Source: Field data (2024)

Another demographic characteristic for the study was marital status of respondents. Results on marital status is presented in Table 8 below. Most respondents (77%) are married and living with their spouses whereas 22% of respondents are single. Marital status is very prominent in rural areas whereby according to Kanmodi et al. (2023), a family that stays together in a stable relationship can easily mobilize their resources and improve their welfare much better than a disintegrated or single family. Studies have shown that married people have a significant social wellbeing advantage over

non-married cohabiters (Mittal *et al*., 2023). These results are similar to the results of Bishagazi (2020).

4.4 Presentation of the Findings of the Study

This subsection presents and discusses findings relating to the study's results. Subsection 4.4.1 provides a discussion of findings relating to the main barriers affecting EM in ASM; subsection 4.4.2 provides a discussion of findings relating to the level of environmental management compliance and practices in the ASM sub-sector; while; subsection 4.4.3 provides a discussion of findings relating to the identification of the framework for the stakeholders' engagement in the EM in the ASM sub-sector.

4.4.1 Challenges affecting environmental management in Artisanal and Small-Scale Mining (ASM)

This subsection presents and discusses findings relating to the main challenges affecting environmental management in Artisanal and Small-Scale Mining (ASM). Constructs used to measure these challenges included lack of awareness, difficulty with environment issues, lack of specialists, lack of EM knowledge, lack of leading initiatives, complex documentation process, high cost of EM implementation, negative attitude of AS miners, ambiguity in legal interpretations, multi-layered sub-contracting, limited stakeholders' pressure, resistance to training and lack of EMS training and education. Subsection 4.4.1.1 discusses descriptive findings while subsection 4.4.1.2 discusses regression results.

4.4.1.1 Descriptive Statistics on the main challenges affecting environmental management in Artisanal and Small-Scale Mining (ASM)

Table 9 below provides descriptive statistics for the main challenges affecting environmental management in Artisanal and Small-Scale Mining (ASM) which was measured using 10-point Likert scales. Table 9 below shows the mean values and standard deviations of the main challenges which affect environmental management in the ASM. The results show that "Lack of EM knowledge" had the highest mean value of 79% while "Lack of awareness" ranked second with a mean value of 77%. "Limited stakeholder pressure" ranked third (i.e. mean = 76%), while "Lack of EMS training and education" ranked fourth with mean values of 72%. Challenges that ranked least is "Ambiguity in legal interpretations" with a mean value of 43%. Similar results were reported by (Ojo & Ogunsemi, 2019). Moreover, the results further show that there are no outliers in the series since the Standard Deviations (SD) are relatively low. This implies that the variability of the dataset of this study based on the opinions of the respondents is minimal (Oke and Aghimien, 2018).

Table 4.8: Descriptive statistics on the main challenges affecting environmental management in Artisanal and Small-Scale Mining (ASM)

Challenges	Observation	Mean	Std. Deviation
AWARE	100	0.77	0.42
ENVIRON	100	0.59	0.17
SPECIALIST	100	0.64	0.31
KNOWLEDGE	100	0.79	0.29
INITIATIVE	100	0.63	0.45
COMPLEX	100	0.58	0.27
COST	100	0.57	0.27
ATTITUDE	100	0.61	0.42
AMBIGUITY	100	0.43	0.17
CONTRACT	100	0.57	0.31
STAKE	100	0.76	0.47
RESIST	100	0.59	0.39
TRAIN	100	0.72	0.46

Source: Field data (2024)

4.4.1.2 Diagnostic Tests

The researcher conducted a regression analysis to determine important challenges affecting EM in ASM. Nonetheless, OLS regression analysis requires certain assumptions to be fulfilled because each independent variable is examined based on its unique predictableness of the outcome variable. This will enabled the researcher to achieve unbiased estimates of the study parameters. This section evaluates whether each assumption the regression analysis were meet with respect to the current data.

Generalizability Test: One of the basic assumptions of the multivariate regression is the generalizability assumption which requires the sample size to have a certain size. Although several theorists have offered different methods of determining the appropriate sample size for generalizability assumption, Cohen (1992)'s method is a straight forward method based on more rigorous rules. According to Cohen (1992), given that the sample size, the number of the independent variables and the effect size are known, the minimum required sample size for a for data set with 5 independent variables is 90. With the current data set of 100 sample size for this study, the generalizability assumption is met.

Multicollinearity Test: A second important assumption that should be met before performing a multivariate regression is the Multicollinearity assumption which requires that no significant relationship should exist between independent variables of the model. Multicollinearity was tested using the Tolerance Value and Variance

Inflation Factor (VIF) whereby a Tolerance value of less than 1 and VIF value of more than 10 indicates presence of multi-collinearity.

Table 4.9: Collinearity statistics for the regression model

Model	Collinearity Statistics	
	Tolerance Value	VIF
AWARE	0.438	2.771
ENVIRON	0.589	2.902
SPECIALIST	0.483	2.821
KNOWLEDGE	0.376	2.992
INITIATIVE	0.521	3.112
COMPLEX	0.364	2.997
COST	0.568	2.756
ATTITUDE	0.701	3.073
AMBIGUITY	0.537	3.893
CONTRACT	0.449	3.832
STAKE	0.629	2.969
RESIST	0.642	2.942
TRAIN	0.641	2.632

Source: Field data (2024)

Results of the multi-collinearity tests are displayed in Table 10 above. All the independent variables for the model have VIF value less than 10 and a Tolerance values less than 1. This suggests that there is no multi-collinearity among the independent variables of the model.

Normality, Linearity and Homoscedasticity Tests: According to Fox (2016), before carrying out linear regression analysis, a researcher must ensure that the dataset is normally distributed. A statistical test to check the normality assumption for dataset with a sample size of 100 0bservations or more is the Shapiro-Wilk test. The Shapiro-Wilk test compares the data with normally distributed set of scores with

the same mean and standard deviation. In this statistical test, the null hypothesis is stated that the residuals are normal and the alternative hypothesis assumes that the residuals are not normally distributed.

For this study, the results of the Shapiro-Wilk test are shown in Table 11 below which are based on log-transformed data. With the Sig. values greater than 0.05, the null hypothesis is not rejected, implying that the residuals are normally distributed.

Table 4. 10: Test of Normality for the outcome variable for regression model

			Shapiro-Wilk
	Statistic	Df	Sig.
EMI	0.541	100	0.842
AWARE	0.459	100	0.799
ENVIRON	0.260	100	0.865
SPECIALIST	0.247	100	0.873
KNOWLEDGE	0.261	100	0.796
INITIATIVE	0.228	100	0.783
COMPLEX	0.359	100	0.732
COST	0.233	100	0.753
ATTITUDE	0.289	100	0.755
AMBIGUITY	0.393	100	0.818
CONTRACT	0.392	100	0.719
STAKE	0.285	100	0.876
RESIST	0.412	100	0.723
TRAIN	0.284	100	0.835

Source: Field data (2024)

Linearity was checked by examining the residual scatter plots and based on the scatterplots, the assumption of linearity between the dependent and the independent variables was considered satisfied. Regarding heteroskedasticity which happens when there are large differences between the smallest and the largest observations in

the data set. Since all variables have a normal distribution, then homoscedasticity is already assumed.

Independence Test: Assumption of independence is an important assumption that needs to be satisfied before carrying out a linear regression analysis. Independence means that observations in the dataset are independent of each other. This means that the probability one respondent to be selected into the sample is not affected by another respondent's selection. The use of random sampling technique as a sampling strategy enhances independence of data as each observation is given an equal chance of being selected.

Independence was tested using the Durbin-Watson statistics which searches for serial correlation between errors. The Durbin-Watson statistic for the current data is 2.174 as shown in Table 12 below. This indicates that the residuals are independent.

Table 4. 11: Durbin-Watson test for autocorrelation for the regression model

Autocorrelation	DW Statistic	P
0.0418	2.173	0.784

Source: Field data (2024)

4.4.1.3 Parameter Estimates

The identification of the main challenges affecting EM in the ASM was analysed using OLS regression model. All 13 challenges identified in this study were used. Carrying an OLS regression with the stepwise method, the final model retained only four challenges as independent variables, as the others were removed due to the pr (0.10) criterion.

Table 4.12: Model parameter estimates for the selected predictors

Variable	B	S.E	t-test	p-value
Constant	-5.223	0.037	-1.118	0.011
AWARE	-0.144	0.065	2.196	0.009
SPECIALIST	-0.192	0.058	3.270	0.060
KNOWLEDGE	-0.198	0.067	2.925	0.002
STAKE	-0.175	0.068	2.550	0.003
R^2=0.74, F-ratio= 38, n= 100				

Source: Field data (2024)

From Table 13 above, results of the multiple regression analysis show that lack of awareness (i.e. β= -0.144; p≤ 0.1), lack of specialists (i.e. β= -0.192; p≤ 0.1), lack of EM knowledge (i.e. β= -0.198; p≤ 0.1), and limited stakeholder pressure (i.e. β= -0.175; p≤ 0.1) have significant effect on EM practices in the ASM sub-sector. All these variables are significant in the regression at the 10% level of significance. 74% of the variation of the outcome variable (EM) has been explained by independent variables (R^2=0.7 4). The F-value (38) shows the importance of these independent variables in influencing EM (Table 13).

The final regression model that was used in this study is shown below:

EM = α + -0.144 AWARE+ -0.192 SPECIALIST + -0.198 KNOWLEDGE + -0.175 STAKE+ ε

(i)

Where: -

EM= Environmental Management

α = intercept or a constant (the value of EM when Independent Variables are 0).

β_1 to β_4 = regression coefficients of the modal (change induced by each coefficient in Y).

AWARE= Lack of awareness

SPECIALIST= Lack of specialists

KNOWLEDGE= Lack of EM knowledge

STAKE= Limited stakeholder pressure

ε = the error term

4.4.1.4 Discussion of Findings

Findings of this study show a significant and negative relationship between lack of awareness variable and EM in the Artisanal and small-scale mining in Tanzania with a coefficient of -0.144. Results indicate that lack of awareness by AS miners on EM issues could reduce the implementation of EM in the ASM sub-sector by 14.4%. According to Ojo *et al.* (2021), implementation of EMS in the ASM sub-sector is largely affected by low awareness of EMS. With the low level of awareness, the efficiency of the EMS which ought to help AS miners lessen their harmful impact to the natural environment is abridged (Marimuthu *et al.* (2021). "Lack of awareness" of EMS makes achieving sustainability practically impossible (Ojo *et al.*, 2021).

Numerous studies have evidenced that a significant relationship exists between "lack of awareness" and EM. For example, Mabrouk and Ibrahim (2021) found a significant relationship between "lack of awareness" and EM. These same results were found by (Tuokuu *et al.*, 2019). Nonetheless, a study by Ojo *et al.* (2021) which investigated challenges facing EMS implementation in Nigeria's mining sector concluded that a non-significant relationship exists between "lack of awareness" and EMS.

Secondly, OLS regression results in Table 4.12 above shows that the coefficient of "lack of EM specialists" is negative and significant (β= -0.192, p=0.060). Results indicate that lack of EM specialists could reduce the implementation of EM in the ASM sub-sector by 19.2%. This conforms with the findings of Yaghi and Eklund (2022) whereby the variable "lack of EM specialists" was found to have a negative and significant impact on EM. Mbewe (2017) also concluded that "lack of EM specialists" contributed to poor implementation of EMS by AS miners in developing countries. The study further imply that inadequate specialists to provide EM trainings increases the likelihood of non-implementation of EM. This is in line with findings of Olalekan and Jumoke (2017)'s study that availability of few EM specialists as one of the main reasons why many firms fail to implement EMS. This notwithstanding, Iyombe et al. (2017) concluded that the impact is very small.

Thirdly, the negative impact of inadequate EM knowledge on EMS implementation may be evidenced from significant coefficient of the variable "lack of EM knowledge" shown in the results presented in Table 4.12 above (β =-0.198, p=0.020). It is observed that "lack of EM knowledge" variable has a negative sign and is statistically significant, meaning that increase in lack of EM knowledge by 1 unit will decrease EM implementation by 19.8%. The results are similar to the results of Zhang et al. (2020) who showed that, as the problem of EM knowledge increases, EMS implementation is more likely to be reduced. Lack of knowledge is always a hindrance to the implementation of a new methodology (Mabrouk & Ibrahim, 2021). (Mutagabwa, 2018) emphasizes that lack of knowledge in environmental issues is a barrier to EMS implementation and sustainability in the mining sector. This is also a

major obstacle to EMS implementation in the ASM sub-sector of developing nations (Kinyondo & Huggins, 2020). In ASM, participation that results in an improved environmental performance depends on the deployment of knowledge about environmental issues and the ability to accept innovative situations (Bishagazi, 2020).

Fourthly, findings of this study show a significant and negative relationship between limited stakeholder pressure variable and EM in the Artisanal and small-scale mining in Tanzania with a coefficient of -0.175. This implies that limited stakeholder pressure could reduce the implementation of EM in the ASM sub-sector by 17.5%. According to Tackie (2020), limited pressure from stakeholders on environmental management has a significant effect on the competitive advantage in then extractive industry. Specifically, in Tanzania, the ASM sub-sector lacks strong pressure from stakeholders in this aspect (Kinyondo & Huggins, 2021). According to Mutagwaba *et al.* (2018), pressure from stakeholder could increase social and environmental consciousness. Numerous studies have evidenced that a significant relationship exists between "limited stakeholder pressure" and EM. These include Ojo *et al.* (2018). However, Mabrouk and Ibrahim (2021) concluded that limited stakeholder pressure has no significant relationship with EM in the ASM sub-sector. A study by Owalana and Booth (2016) which investigated challenges facing EMS implementation in Nigeria's mining sector concluded that a non-significant relationship exists between "lack of awareness" and EMS.

Generally, the results are in line with the Stakeholders' Theory where the relationship between challenges and EM practices is negative. Societal expectations about the environmental, social, and cultural 'performance' of industries involved in the development, use or management of natural resources have changed over recent decades. Communities have increased expectations regarding the benefits they receive from the presence of such industries, along with assurances that the industry is properly regulated. Generating trust in the mining industry and its operators is an important driver of social acceptance in mining (Tackie, 2020).

4.4.2 The Extent of Environmental Management Compliance and Practices in Artisanal and Small-Scale Mining (ASM)

Land degradation, loss of local biodiversity, leakage of chemicals from mining processes, and noise and visual pollution are high impacts that mining activities may have on the environment. Therefore, one of the main reasons to implement an environmental management system is the pressure from society for a cleaner and sustainable environment" Figure 2 below shows that the level of EM compliance and practices among AS miners in Tanzania is currently 27%. The core motivation for implementing environmental system are mainly linked to image and reputation, a factor that is not relevant for AS miners. Bishagazi (2020) reported that the level of EM implementation among AS miners in Tanzania was 10%. Therefore, there is an improvement level of EM implementation among AS miners in Tanzania. Nonetheless, this rate is still small. For example, the level of EM implementation among AS miners in other developing countries such as Nigeria and South Africa is (42.2%) and (67%) respectively (Ojo *et al*., 2021).

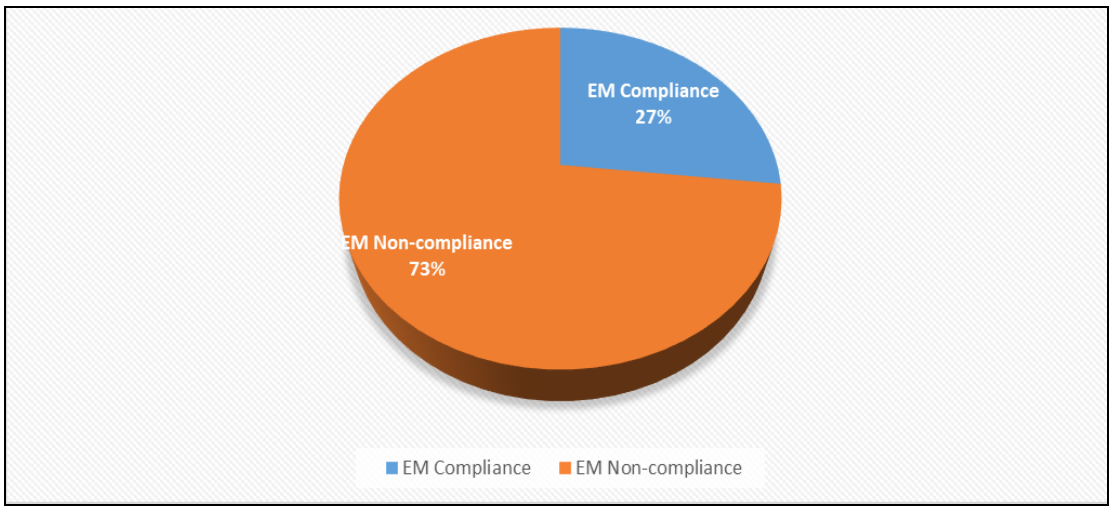

Figure 4.1: The extent of environmental management compliance and practical in Artisanal and Small-Scale Mining (ASM)

Source: Field data, 2024

Analyzing specific EM items, item 3 which enquired whether environmental responsibilities and authorities within our mining site are fixed and clear had the highest average of 72% while the item "Our mining site takes into account any potential sources of pollution resulting from its activities while planning these activities" ranked the second (mean = 63%).

Table 4.13: Table 14: Descriptive Statistics on the Extent of EM implementation

Code	Statements	N	Mean	Std. Deviation
EM 1	Our mining site has its own environmental policy.	100	0.56	1.45
EM 2	Within our budget there is a special item for environmental affairs in this mining site	100	0.42	1.20
EM 3	The environmental responsibilities and authorities within our mining site are fixed and clear	100	0.71	1.34
EM 4	There is an environmental record in our mining site	100	0.02	1.25
EM 5	Our mining site takes into account any potential sources of pollution resulting from its activities while planning these activities	100	0.63	1.35
EM 6	I can easily identify some impacts of my mining activities on the environment in the form of discharge to water, emissions to air, and waste products.	100	0.07	1.22
EM 7	Restoration plans and the annual waste declaration are mandatory, thus EM practices are adopted by 100% of the mining sites.	100	0.00	0.00
EM 8	Specific environmentally focused training programmes are established for miners in our mining site whose work may have deleterious impacts on the environment	100	0.16	1.31
EM 9	Our leaders in our site revise the environmental policies and targets periodically in order to ascertain their effectiveness and appropriateness	100	0.37	1.27
EM 10	We take account of possible effects of our activities, and we adopt a variety of measures to control work and develop periodic plans for restoring the initial conditions	100	0.34	1.74
EM 11	In our mining site, we have implemented at least three different environmentally sustainable practices.	100	0.00	1.16
EM 12	In our mining site, we have adopted procedural practices such as environmental goals, definition and environmental emergency protocols	100	0.21	0.91
EM 13	Our mine carries out EIAs periodically	100	0.00	0.00

Source: Researcher (2024)

In addition, descriptive statistics from Table 4.13 show that about 56% of the respondents indicated their mining sites have an EM policy and only 8% said that their mining sites are in the process of implementing it or intend to do it. Moreover, results show that 42% of artisanal and small–scale miners' budgets contain a special item for environmental affairs. This technique ranks fourth as the most applied EM practice. The EM practice that ranked fifth is "our leaders in our site revise the environmental policies and targets periodically to ascertain their effectiveness and appropriateness", with a mean value of 37%.

The presence of the environmental record in the mining site and the item "the environmental responsibilities and authorities within our mining site are fixed and clear" with equal percentage ranking. In addition, the item "Our mining site takes into account any potential sources of pollution resulting from its activities while planning these activities" has a low mean value of 63%. Moreover, the item "Our leaders in our site revise the environment" is not applied, as shown in Table 4.13.

In addition, only 7% of the respondents could easily identify some impacts of their activities on the environment in the form of discharge to water, emissions to air, and waste products. The study findings add to the observation of Olalekan and Jumoke (2017), who pointed out that implementing environmental management systems by artisanal and small–scale miners is associated with passive miners who cannot identify basic environmental management issues.

Descriptive statistics show that EIAs are not conducted at all by artisanal and small–scale miners, which could be attributed to the fact that artisanal and small–scale

miners without an environmental management system implemented do not usually perform these audits. Similarly, artisanal and small–scale miners do not implement environmentally sustainable practices (mean = 0). According to Bishagazi (2020), artisanal and small–scale mines with an environmental management system adopted more sustainable practices than artisanal and small–scale miners without an environmental system. This can be attributed to the fact that implementing an environmental system involves introducing several practices inherent to the system itself.

Meanwhile, only 20% of respondents agreed that their mine adopted procedural practices such as environmental goals definition and environmental emergency protocols. This problem makes it difficult for government agencies to penalize industries polluting the environment in the country. A tighter legislation will repel industrialists from investing in the country.

4.4.3 A Framework for Stakeholders' Engagement in Environmental Management in Artisanal and Small-Scale Mining (ASM)

People have a stake in environmental management in the ASM for their interests and the sake of the environment itself. In recent decades, environmental decision-making has changed somewhat to account for unintentional impacts on human well-being. The involvement of stakeholders in the environmental management of ASM is important because they are crucial in determining key benefits and challenges of EM. Therefore, this study sought to propose a framework for stakeholder engagement in the ASM for effective, efficient and meaningful engagement of stakeholders. In

Nyarufuko, the purpose of stakeholder participation and engagement is to enhance the quality of environmental management for artisanal and small–scale miners.

Based on data collected through interviews and questionnaires, a comprehensive framework for designing adequate stakeholder engagement, shown in Figure 4.2 was proposed and discussed. It is structured as a system with inputs (e.g. environmental policy), outputs (e.g. decisions) and processes. To implement such a system, stakeholders must be identified, characterized and organized to give them a specific degree of participation, thereby accounting for their heterogeneity. Participatory techniques must then be chosen according to the specified degree of participation. Finally, an evaluation must be conducted when the entire process has been completed.

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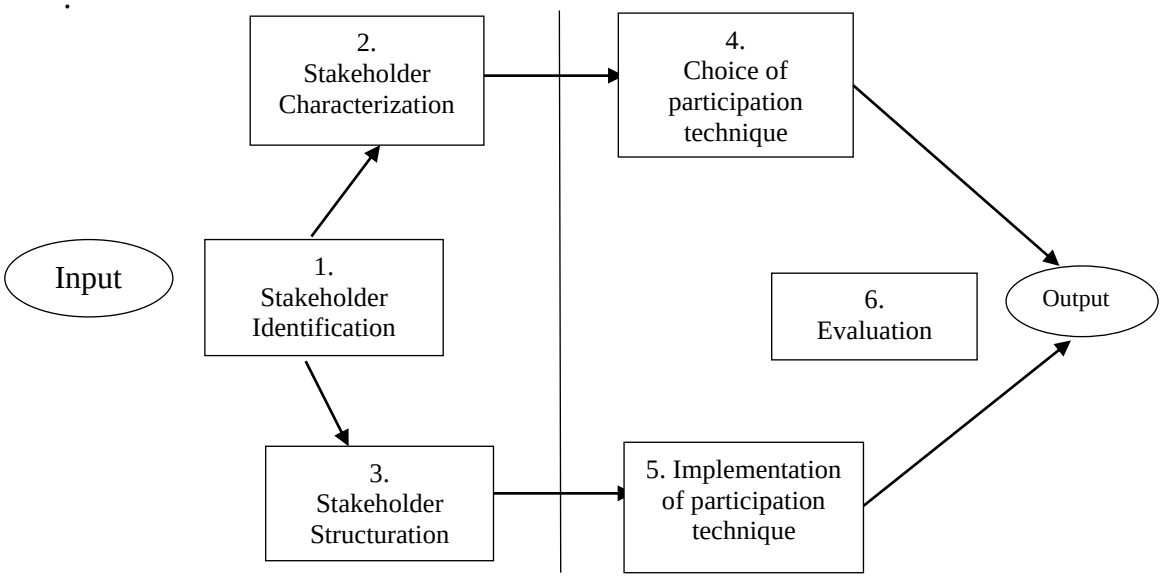

Figure 4.2: Proposed Framework for Stakeholder Engagement

Source: Researcher, 2024

In the second step, four criteria were used to characterize the identified stakeholders. These criteria are involvement, resources, political influence and attitude towards EM. These criteria are considered very relevant in the early stage of EM implementation. For the third step of the framework (stakeholder structuring and degree of involvement), 7 questions of the Vroom model were answered for each stakeholder. The answers were studied with a cluster analysis, which allowed the identification of four degrees of involvement: information, consultation, collaboration, and co-decision.

The degree of involvement and the EM phase should be considered for the choice of participatory technique. These techniques were selected based on their potential to identify stakeholder objectives regarding EM. Information (newsletter production, public hearings), consultation (interviews and questionnaires), cognitive maps, multi-criteria analysis, scenario analysis, consensus conferences) and co-decision (advisory boards and workshops) were undertaken at different scales.

The last step of the proposed framework is a first qualitative evaluation. In this stage, stakeholders should be interviewed to show what each stakeholder learned and how they understood the issues related to EM. During these interviews, 13 criteria have been used: design of the process, integration of every interest, transparency, equity, definition of the rules, early involvement, facilitation, stakeholder representativeness, stakeholder competency, trust, social learning and impact of participation of the process and results.

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CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the major conclusions from the study and its main recommendations. Section 5.2 provides a summary of the study, and section 5.3 discusses the study's conclusions, section 5.4 provides the study's main recommendations and section 5.5 provides recommendations for future research.

5.2 Conclusion

Generally, EM practices are narrowly implemented in the ASM sub-sector in Tanzania due to several challenges. Specifically, lack of knowledge of EM, the bureaucratic bottleneck of EM implementation and absence of continuous improvement culture succinctly describes the challenges impeding EM implementation in the ASM sub-sector. Moreover, the analysis revealed low levels of EM implementation across the sample. Findings from the questionnaire suggest that the AS sub-sector adopts a predominantly reactive approach to dealing with environmental management challenges. Most miners are not sufficiently aware of their impacts on the environment, which helps explain the simplistic EM practices they currently have.

5.3 Recommendations

5.3.1 Challenges Affecting Environmental Management in Artisanal and Small-Scale Mining (ASM)

Regarding the first objective, the government and other stakeholders should conduct

advocacy programmes through different media on the benefit of EM implementation, particularly for artisanal and small–scale miners. Moreover, the government should also provide facilities to assist in training artisanal and small–scale miners on environmental sustainability. Training and education programmes by Tanzanian tertiary institutions and construction professional bodies are recommended. The training will increase awareness and promote a continuous improvement culture among artisanal and small–scale miners.

5.3.2 The Level of Environmental Management Compliance and Practices in Artisanal and Small-Scale Mining (ASM)

For the second objective, this study recommends that the government should play an active role by making and enforcing environmental laws and regulations to curb complacency to environmental issues among artisanal and small–scale miners. In addition to that, policymakers should design policies that promote sustainable mining. This includes establishing training centres that will train artisanal and small–scale miners on environmental management and sustainable mining.

5.3.3 A Framework for Stakeholders' Engagement in Environmental Management in Artisanal and Small-Scale Mining (ASM)

For the third objective, artisanal and small–scale miners need to identify our key stakeholders and incorporate them into their operations, particularly environmental management practices. Society is increasingly environmentally responsible; thus, miners have to be responsible and redefine their processes to respect the environment.

5.4 Areas for Further Study

First, this study measured environmental management using 13 items. Nonetheless, there are other measures of EM such as ISO 14000 family, including ISO 14001 on Environmental management systems - Requirements with guidance for use; ISO 14004 Environmental management systems - General guidelines on implementation, ISO 14005 Environmental management systems - Guidelines for a flexible approach to phased implementation, and ISO 14006 Environmental management systems - Guidelines for incorporating ecodesign. Therefore, future researchers could use these measures for EM studies. In addition, the current study sought to investigate challenges affecting EM in the ASM sub-sector. However, the variables used in the study were not exhaustive. Future research could incorporate more challenges not used in the current study. Also, the scope of this research was limited to the evaluation of only the ASM sub-sector operating in Tanzania. However, this may vary if other developing countries are included to increase the population. Therefore, in furtherance of the research, one might want to consider this research as a reference to expand the scope and improve the research results.

The scope of the study was constrained in terms of context, whereby only artisanal and small–scale miners were analyzed. Future studies can be extended to other types of natural resources in the extractive industry to establish if they complement or contradict the current study's findings. Moreover, this will enable policymakers and decision-makers to determine potential differences and similarities in the behaviour of each category of natural resources.

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APPENDICES

Appendix I: Research Instrument: Questionnaires

Dear Mr/Mrs/Miss

I am Ernest Kafu a student at the Open University of Tanzania, am conducting research to examine challenges of environmental management in the Artisanal and Small Scale Mining (ASM) in Tanzania. Kindly, complete the attached field survey which will take your precious time of 7 minutes. Your response will be unnamed and treated confidential. The input collected is very important in getting the accurate findings which will reflect the actual scenario of challenges environmental management in the Artisanal and Small-Scale Mining (ASM) in Tanzania that will ensure validity of this research. There is no right or wrong answer and information delivered from this questionnaire will be used for research purpose only and will not be shared with any other parties or organization.

Thank you for accepting to participate in the research project. Your participation in this research is voluntary and valuable to me as I am conducting this study.

Yours sincerely,

Ernest Kafu
+255 762 961 420
kafuworld@yahoo.co.uk

SECTION I: Respondent's Socio-Economic and Demographic Information

 Please mark (√) the most appropriate answer to the following phrases:

1.	Gender	Male	( )
		Female	( )
2.	Age	……years	
3.	Marital Status	Married	( )
		Single	( )

4.	Income Level	Less than Tshs. 50, 000 per month	( )
		Tshs. 50, 000- Tshs. 300, 000	( )
		Tshs. 300, 001- Tshs. 500, 000	( )
		Tshs. 500, 001- 1,000, 000	( )
		Above Tshs. 1, 000, 000	( )
5.	Education	Primary or Less	( )
		Secondary	( )
		University or College and Above	( )
6.	Do you have a mining license?		( ) Yes
			( ) No
7.	Number of artisanal and small–scale miners at your mining site:		……
8.	Establishment date at this site:		……
9.	Do you perform environmental management practices at this site?		( ) Yes
			( ) No
10.	If the above answer is Yes, which was the date of initiating environmental management practices at this site?		……...

SECTION II: The Characteristics and Efficiency of Environmental Management Practices in the ASM Sites

Please mark (√) the most appropriate answer to the following phrases:

11. Our mining site has its own environmental policy.

a.) Strongly Agree	[ ]	b.) Agree	[ ]
c.) Neutral	[ ]	d.) Disagree	[ ]
e.) Strongly Disagree	[ ]		

12. If your answer is (Strongly agree) or (Agree) - Give an example, please: .....

13. Within our budget there is a special item for environmental affairs in this mining site.

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

14. If your answer is (Strongly agree) or (Agree) - Give an example, please: .....

15. The environmental responsibilities and authorities within our mining site are fixed and clear.

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

16. If your answer is (Strongly agree) or (Agree) - Give an example, please: .....

17. There is an environmental record in our mining site.

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

18. If your answer is (Strongly agree) or (Agree) - Give an example, please:

19. Our mining site takes into account any potential sources of pollution resulting from its activities while planning these activities.

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

20. If your answer is (Strongly agree) or (Agree) - Give an example, please:

.....

21. Specific environmentally focused training programmes are established for miners in our mining site whose work may have deleterious impacts on the environment.

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

22. If your answer is (Strongly agree) or (Agree) - Give an example, please: .....

23. Our leaders in our site revise the environmental policies and targets periodically in order to ascertain their effectiveness and appropriateness.

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

24. If your answer is (Strongly agree) or (Agree) – How many times per year: .....

25. There is an effective system within our site to enforce the application of instructions concerned with environmental affairs

a.) Strongly Agree [ ] b.) Agree [ ]

c.) Neutral [ ] d.) Disagree [ ]

e.) Strongly Disagree [ ]

26. If your answer is (Strongly agree) or (Agree) – What is the system? .....

SECTION III: Challenges to Environmental Management

Please, from your experience, rank the following challenges from 1 to 10 according to its importance (1 is most important – 10 is less important):

27. Lack of Awareness
28. Difficulty with environment issues

29. Lack of Specialists
30. Lack of EM Knowledge
31. Lack of leading initiatives
32. Complex documentation process
33. High cost of EM implementation
34. Negative attitude of artisanal and small–scale Miners
35. Ambiguity in legal interpretations
36. Multi-layered sub-contracting
37. Limited stakeholders' pressure
38. Resistance to training
39. Lack of EM training and education

SECTION IV: The Possible Environmental Benefits to Be Derived from Implementing EM practices.

Please, from your experience, rank the following challenges from 1 to 10 according to its importance (1 is most important – 10 is less important):

No	Benefits of Environmental Management	Ranking
40.	EM practices improve the environmental capability and performance of our mining site.	
41.	EM practices provide a harmonized system for managing environmental impacts.	
42.	EM practices define environmental objectives and targets.	
43.	EM practices involve regular and periodic measurements of the levels of environmental impact derived from the mining activities.	
44.	EM practices improve the operational safety of the site.	
45.	EM practices raise the level of environmental awareness among the artisanal and small–scale miners through training sessions.	
46.	EM practices enhance miners' participation in environmental management activities.	
47.	Increasing environmental performance will enhance the image	

of the ASM activities.

48. EM practices can offer improvements in environmental performance and could possibly improve market competitiveness in the longer term.
49. EM practices assist in avoiding legal sanctions, for example, forfeiture of operating permits and financial fines and penalties that hamper mining activities.
50. EM practices assist in providing regular periodic reports about the extent of adherence to established environmental standards.

SECTION V: Support Needed to Overcome Challenges Experienced by ASM In Complying with Environmental Management

Please, from your experience, rank the following challenges from 1 to 10 according to its importance (1 is most important – 10 is less important):

No.	Support Needed to Overcome Challenges	Ranking
51.	Implementation guideline Technology transfer	
52.	Technical consultancy	
53.	Training and awareness	
54.	Financial support	

Appendix II: Interview Guide for Representatives of the Governmental Officials

1. What do you think are the key reasons and needs of those involved in small-scale mining with regard to environmental management?

2. Is the existing EM policy being used in the ASM?

3. How is the EM policy implemented?

4. How effective is this EM policy?

5. What are some of the challenges for the implementation of the EM policy?

6. Comparing the situation of illegal small-scale mining, would you consider the situation more or less after the implementation of the policy?

7. What are some of the key reasons that the practice persists?

8. What do you think is needed to be done to further curb the practice?

9. Has the practice increased or decreased in the last decade? If yes……..why?

Appendix III: Ethical Documents

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

THE OPEN UNIVERSITY OF TANZANIA

Ref. No OUT//PG201986774 **22nd August, 2024**

District Executive Director (DED),
Mbogwe District Council,
P. O. Box 01,
GEITA.

Dear Director,

RE: RESEARCH CLEARANCE FOR MR. ERNEST KAFU REG NO: PG201986774

2. The Open University of Tanzania was established by an Act of Parliament No. 17 of 1992, which became operational on the 1st March 1993 by public notice No.55 in the official Gazette. The Act was however replaced by the Open University of Tanzania Charter of 2005, which became operational on 1st January 2007.In line with the Charter, the Open University of Tanzania mission is to generate and apply knowledge through research.

3. To facilitate and to simplify research process therefore, the act empowers the Vice Chancellor of the Open University of Tanzania to issue research clearance, on behalf of the Government of Tanzania and Tanzania Commission for Science and Technology, to both its staff and students who are doing research in Tanzania. With this brief background, the purpose of this letter is to introduce to you **Mr. Ernest Kafu, Reg.No: PG201986774),** pursuing **Masters of Environmental Studies (MES).** We here by grant this clearance to conduct a research titled **"The Challenges of Environmental**

Management in the Artisanal and Small Scale Mining (ASM) In Tanzania: A Case of Nyakafulu Gold Rush in Mbogwe District, Geita Region". He will collect His data at your area from 23rd August 2024 to 30th October 2024.

4. In case you need any further information, kindly do not hesitate to contact the Deputy Vice Chancellor (Academic) of the Open University of Tanzania, P.O.Box 23409, Dar es Salaam. Tel: 022-2-2668820.We lastly thank you in advance for your assumed cooperation and facilitation of this research academic activity.

Yours sincerely,

THE OPEN UNIVERSITY OF TANZANIA

Prof.Gwahula Raphael Kimamala

For: VICE CHANCELLOR

Kinondoni Biafra, Kawawa Road; P.O 23409; Dar es Salaam; Tel: +255 22 2668 445;
E-Mail:vc@out.ac.tz|| Website:www.out.ac.tz

THE UNITED REPUBLIC OF TANZANIA
PRESIDENTS OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT AUTHORITY
MBOGWE DISTRICT COUNCIL

In reply, please quote
Ref. No.MDC/ADM/C.30/VOL II/106

1ST November, 2024

THE VICE CHANCELLOR
OPEN UNIVERSITY OF TANZANIA
Kinondoni Biafra, kawawa road.
P.O.BOX 23409
DAR – ES – SALAAM

REF: RECOMMENDATION LETTER FOR MR. ERNEST KAFU REG NO. PG201986774

The heading above refers

2. Mr. Ernest Kafu, arrived on 28th August, 2024 at Mbogwe District Council for the purpose of data collection as per his letter with Ref. No. OUT/PG201986774 dated 22nd August, 2024 and research title **"The Challenges of Environmental Management in the Artisanal and Small-Scale mining (ASM) in Tanzania: A case of Nyakafulu Gold Rush in Mbogwe District, Geita Region".**
3. Mr. Ernest Kafu undertook data collection excise under supervision of head of department of Natural resources and Environmental conservation.
4. During his presence (from 28th August – 30th October, 2024), Mr. Ernest was very useful and resourceful in terms of advice on environmental management issues in general.
5. Therefore, I am pleased to recommend Mr. Ernest Kafu Reg NO. PG201986774 that, he was successfully undertaken data collection pursued to his research titled "**The Challenges of Environmental Management in the Artisanal and Small-Scale mining (ASM) in Tanzania: A case of Nyakafulu Gold Rush In Mbogwe District, Geita Region".** With no doubt, this research will add values to

Mbogwe District strategies for combating environmental challenges aggravated by Artisanal and Small scale Gold miners.

6. Please, don't hastate to contact Mbogwe District Council if more clarifications are needed.

7. Sincerely yours,

MARCEL J.K

For: District Executive Director

MBOGWE.

FOR: DISTRICT EXECUTIVE DIRECTOR
MBOGWE

CC: District Executive Director – Mbogwe District council

Ofisi ya Mkurugenzi Mtendaji Wilaya, S.L.P. 01, Masumbwe – **Mbogwe**. Mkoa wa Geita
Barua pepe: ded@mbogwedc.go.tz