

**ASSESSMENT OF THE EFFECTS OF QUARRYING ACTIVITIES ON THE
ENVIRONMENT: A CASE STUDY OF LENGIJAVE VILLAGE, ARUSHA
DISTRICT, TANZANIA**

LOISILIGAKI WILLIAM

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN
NATURAL RESOURCE ASSESMENT AND MANAGEMENT OF THE OPEN
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CERTIFICATION

The undersigned certifies that, he has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation titled: “*Assessment of the Effects of Quarrying Activities on the Environment: A Case Study of Lengijave Village, Arusha District*” in partial fulfilment of the requirements for the Degree of Master of Arts in Natural Resource Assessment and Management of the Open University Tanzania

.....

Dr. Emmanuel Patroba Mhache

Supervisor

.....

Date

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DECLARATION

I, **Loisiligaki William**, do hereby declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

.....

Signature

.....

Date

DEDICATION

I dedicate this dissertation to the Almighty God, the creator of the universe for having kept me healthy during the writing of this dissertation. He was always there to listen and answer my prayers. I also dedicate this work to my beloved wife Lilian Michael Makule, my mother Florah Sironga Kivuyo for their material and moral support. I further dedicate this work to my children Charity, Jaden and Jayon. Last but not least I dedicate this work to my brother Dr. Michael Karani who encouraged me since I began my studies.

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ABSTRACT

The main aim of this study was to unearth the effects of quarrying activities on the physical environment in Lengijave Village in Arusha District. The general objective of this study was to assess the effect of quarrying activities on the environment on Lengijave Village. Specifically this study identified environmental effects of the gravel quarry activities on the study area, examined local community awareness on the effects of quarrying activities on the environment and determined measures to address the effects of gravel quarrying activity on the environment. The target population of this study was heads of households, quarry workers and quarry owners. Questionnaires, interview, observation and documentary literature review were used for data collection. Questionnaires were administered to heads of households, quarry workers, quarry owtheners and people living next to the quarries to gather the required data. Direct observation was used to identify the effects of quarrying activities on the environment. Stratified random sampling technique was used to get a sample of 99 respondents, which was used to answer research questions. The information collected was analyzed using SPSS to generate frequencies and statistical tables for the interpretation of data. Further, content analysis was used for data collected using interviews. The findings of the study indicated that workers did not have protective gears which are a requirement in their profession. This increases the effects of the health of the quarry workers. The findings showed that regardless of the important role that quarrying activities played in the economic growth; it resulted in negative effects on the environment such as soil erosion, land degradation, biodiversity loss as well affected the human health in general. The study recommended training to quarry workers, the community should be given entrepreneurial skills so that they engage in other activities for then to earn income for their families. This will reduce the concentration on the gravel quarrying activities and the government should revoke licenses of that those quarrying owners who do not adhere to the set of laws.

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LIST OF ABBREVIATIONS

EIA	Environmental Impact Assessment
FAO	Food Agriculture Organization
FGD	Focus Group Discussion
NBS	National Bureau of Statistics
NEP	National Environmental Policy
OUT	The Open University of Tanzania
UNESCO	United Nations Educational, Scientific and Cultural Organization
URT	United Republic of Tanzania
VEO	Village Executive Officer
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter presents the introduction, background of the research problem study, statement research of the problem and objectives of the study. It further presents research questions, the scope of the study and the significance of the study.

1.2 Background of the research problem

All over the world, there is a realization that quarrying activities have increased with time (Nene, 2011). Quarries are generally used for extracting construction materials such as dimension stone, ornamental stones for road construction, building and industrial raw materials. A quarry is a type of open-pit surface mining from which rock or minerals are extracted. It is obvious mining and quarrying are destructive enterprises (Sinha, *et al.* 2000) and involve the destruction of the natural habitats and loss of ecosystems (Martínez-Ruiz *et al.* 2007; Masalu 2010). The destruction and fragmentation of habitat is the greatest threat to biodiversity and the primary cause of species extinction (Aronson *et al.*, 1993; Masalu 2010).

In most Africans nations and other nations, quarrying is not well managed for environmental sustainability (Darwish *et al.*, 1992; Masalu 2010). The methods used in quarrying are very poor and quarrying activities are not sustainable (Nene, 2011). Most of the quarries do collapse and there are no measures taken to rehabilitate to such quarries since most of them are left open. Therefore, the need for the detailed study on the significance of quarrying management on mining industries has become inevitable. Since the effects of quarrying cover all tenants of effective strategic

management, ethical corporate governance and ensure quarrying are managed in an integrated and structured manner that boosts institutions in quarrying perform (Nyakeniga, 2009). One of the major negative impacts of quarrying on the environment is the biodiversity loss (Anand, 2006; Masalu, 2010). Quarrying activities destroys natural habitats and the entire ecosystem (Mabogunje, 2008; Masalu, 2010; Nene, 2011). Even if the habitats are not directly removed by excavation, they can indirectly be affected through changes to ground water or surface water that causes some habitats to dry out or others to become flooded. These changes can alter the hydrology, water quality, and salinity (Masalu, 2010; Nene, 2011). Air pollution from quarry dust and noise from vehicles, machinery, blasting and noise leads to a significant impact to animal species and affect their success in reproduction (Nene, 2011). However, environmental parameters such as strong winds and dry weathers have facilitated emission of dust at a certain ecosystem (Nene, 2011).

Nevertheless, with careful planning and management it is possible to minimize the effect of quarrying on biodiversity. Like many other man-made activities it involves the production of significant amounts of waste like dust hence polluting the ecosystem (Nene, 2011). Some types of quarries do not produce large amounts of permanent waste, such as sand and gravel quarries, whereas others will produce significant amounts of waste material such as clay and silt (Wang, 2007; Nene, 2011). The good news is that they are generally inert and non-hazardous, unlike the waste from many other processes. However, there is still potential damage for quarrying activities on the environment particularly with water contamination (Nene, 2011).

Poor operation of quarries can cause significant impact to the environment and people around the area which facilitate poor health and poor quality of life which hinders sustainable development (WHO, 199; Masalu, 2010; Nene 2011). The right of planning and management, can facilitate in minimizing and controlling the adverse impacts on the environment and provide a great opportunity towards protection and enhancement of the environment (Nene, 2011). At some point, it was advised to trans-locating the existing habitats or the creation of new ones (Nene, 2011). Therefore, to achieve the equilibrium between natural ecosystems, project planning, formulation and implementation is needed to avoid the impact of gravel quarrying on the environment and living community (Nene, 2011).

Quarrying activities in Lengijave Village in Arusha District have been going on since the 1990s when the place was sparsely inhabited. Currently, the population has grown and therefore it causes the competition of land use in economic activities where formerly it was used for farming and animal grazing. This study is designed to assess the environmental and social impact of gravel quarrying activity at Lengijave Village.

1.3 Statement of the research

Environmental degradation is a result of dynamic interaction between social-economic, institutional and technological activities. The environmental degradation, landslide, environmental pollution and others are the result of human activities. However, land degradation is one of the significant impact arising from mining and quarrying activity which is mainly in the form of alteration of the land structure due to excavation of top soil and loss of land due to dumping of mine waste and overburden soil. Stones and sand quarrying causes damage to property, depletion of groundwater,

loss of fertile topsoil degradation of forest land. Haphazard quarrying of sand from the riverbed leads to damage to infrastructure likes bridges and roads. Without doubt, the most contentious environmental impacts experienced by residents living adjacent to quarries and surface mines are those produced by blasting. This has been confirmed not only anecdotally but also by surveys carried out by mineral planning authorities (William and Hugh, 2006). However several studies have been done on assessing environmental impacts of quarrying activities such as quarrying activities on biodiversity in Ogbere Site, Ogun State Nigeria (Cameed, 2010). Therefore this research assessed the effect of quarrying activities on the environment in Lengijave Village, Arusha District.

1.3 Objectives of the study

1.3.1 General objective

The main objective of this study is to assess the effects of quarrying activities on the environment in Arusha District.

1.3.2 Specific objectives

- (i) To examine environmental effects of quarrying activities on the study area.
- (ii) To examine local community awareness of the effects of quarrying of gravel on the environment.
- (iii) To investigate the intervention measures of gravel quarrying on the environment.

1.4 Research Questions

- (i) What are the effects of a gravel quarry on the environment in the study area?

- (ii) How local communities are aware of the effects of quarrying of gravel on the environment?
- (iii) What are the measures to address the effects of quarrying on the environment?

1.5 Significance of the Study

The findings of this study will be useful in assessing the environmental impacts caused by the quarrying of gravel in Arusha District. The study findings will also help to raise awareness of the community on the effects of quarrying activity in Arusha District. Also, the study will contribute to other researchers and literature on the mining sector. The study will also pave the way forwards to the effects resulting from quarrying activities. This study will inform environmental stakeholders on the effects of improper quarrying activities and ways to control other calamities that are caused by quarrying activities. Example of the effects of quarrying activities is land use conflicts among community members and with the government. The study will help to inform the ministry the damage of mining activities which will help the governments to address the effects caused by quarry activities and update environmental and land use policies.

1.6 Scope of the study

This study will be conducted in Lengijave Village located in Arusha District in Arusha Region.

The study focused on the effects of gravels quarrying activities in the village as well as the local community on the same environment. The study will also suggest

solutions which can be a benchmark for solving problems emanated from gravel quarrying.

1.7 Organization of the dissertation

This dissertation is organized into five chapters. Chapter one presents the introduction, background of the research problem, statement of the research problem and objectives of the study. It further presents research questions, significance of the study and organization of the dissertation. Chapter two presents the literature review and chapter three presents the research methodology. Chapter four presented the findings and discussion of the results. The last chapter presents conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review on the study. It specifically presents introduction, the definition of key concepts, theoretical literature review and empirical literature review. It further presents the research gap, conceptual framework and the summary chapter.

2.2 Definition of concepts

2.2.1 Quarry

A quarry is a large deposit of rock such as granite which is mined for use in a construction project. In short one can say that, a quarry is a type of open-pit mine from which rock material and sand are extracted for the purpose of supporting construction sector (Eshiwani, 2014). Quarries are established when large deposits of commercially useful minerals on rocks are found near the earth's surface (Eshiwani, 2014). Quarrying is the process of extracting stone for commercial use from natural rock deposit. (Sci_Tech Encyclopedia, 2005). Quarrying is a form of mining and is also known as open-pit mining or strip mining. The industry has two major branches which are dimension stone and crushed stone. The dimension stone branch involves the extraction of large chunks of rock of various sizes and shapes for use as a building stone. The crushed stone branch involves preparation of crushed. The general objective of dimension stone quarrying is to produce large rectangular blocks suitable for cutting into a smaller regular-shaped product (Gale and Groat, 2001) unlike other types of mines; quarry is usually not dug out underground.

2.2.2 Environment

The Environment is the total surroundings of a living organism, including natural forces and other living things which provide conditions for development and growth. In other words, the environment is the surroundings in which an organization functions, including air, water, land, natural resources, flora fauna, humans, and their interrelation. Surroundings in this context extend from within an organization to the global system (Raisian and Yahaya, 2015).

2.3 Theoretical Literature Review

2.3.1 Von Thunen and Urban Sprawl

This theory indicates that in many advanced industrialized parts of the world which mostly consists of developed countries, the basic forces determining agricultural land use near urban areas are associated with urban expansion (Alonso, 1960; Sinclair, 1967). This theory can be applied in quarry activities whereby the demand for gravel, stones and sand to the city or nearby urban centers is one of decreasing intensity with distance from the city (Sinclair, 1967). This theory is generally applicable where primary force determining the pattern is only the transport of goods to the market and in this case of assessing the effects of quarry activities the theory is highly applicable (Alonso, 1960; Sinclair, 1967). Basing on the theory the study analyzed the problem of urban expansion which facilitates people from Lengijave village to utilize land within their village and degrade their area hence contribute to the loss of biodiversity (Ngongolo and Mtoka 2013). Sinclair (1967) indicates that similar study took place in United States of America whereby the writer looks on the “*Urban Expansion and its Problems in the United States.*” This theory was used on the study due to the fact

that the expansion of suburban town of Ngaramtoni rely mostly on the quarry products from Lengijave village and the only costs incurred by the villagers is to take gravel to the town with slightest distance from this village.

This theory recognized that this land use pattern depended upon competition between various types of agriculture for the use of a particular piece of land (Alonso, 1960; Sinclair, 1967). The controlling factor in this competition was Economic Rent, defined here as return from investment in the land after utilizing the land for a certain period of time (Alonso, 1960; Sinclair, 1967). In order to get the economic rent depends on what the land has to offer which will make others to come and invest in a particular piece of land (Alonso, 1960; Sinclair, 1967). Von Thunen realized that transport costs were a primary factor determining Economic Rent (Alonso, 1960; Sinclair, 1967). Due to this the transport cost increased with the distance which makes the land owner to decide to increase the cost hence to acquire financial gain (Alonso, 1960; Sinclair, 1967).

2.3 2 System Theory

The theory guiding this study is the systems theory. This section reviews the theory with a view to bringing out the salient attribute that would enable this study to fit in. Similarly the concept of land degradation is also incorporated to further buttress the affect of mining within the system, the general system theory developed by Bertalanffy (1951). He argued that, natural geology consists of mutually related subsystems and the destruction of one of the subsystem lead to modification of the entire system. The environment is the total of all the external factors that influence the life of an organism, here the physical environment which comprise the lands is consider

consequently in the strive for economic growth, the physical and social environment are subjected to pressure that affect the entire system.

The theory emphasizes real systems are open to and interact with, their environment, and that they can acquire qualitatively new properties through emergence resulting in continual evaluation. Thus rather than reducing an entity example (environment) to the properties of its parts or element example land setup. System theory focuses on the arrangement of and relations between the parts which connect them into the whole. The system theory conceptualizes land degradation and negative social and economic effects as the response of the quarrying to demand of the environment. The theory sees land degradation as well as negative social and economic affect as an output of quarrying. Land degradation such as loss of in vegetation cover, changes in the landscape. The theory shows that relationship that unites the part to form a whole have a lot of influence on the behaviour of the whole.

Man affects his environment as he responds to the changing condition set by the environment and the environment responds to the human manipulation, thereby creating a state of dynamic equilibrium that continues to adjust and readjust in space with time (Olofin, 1989). The systems theory was chosen against other theories the world is made up of components and components are interrelated. Therefore, because man depends on mining and the mining is being done on the land, the environment is in turn affected by such activity and land degradation sets in. the relationship between the two is that mining as an input was converted into land degradation as the output in this case. Land degradation which includes degradation of vegetation and soil has

been identified as a major problem in Africa (FAO, 1980) from the foregoing, therefore the system theory sees land degradation as the output of the mining.

2.4 Empirical literature review

2.4.1 Effects of quarrying in different parts of the world

Rock quarrying and stone crushing is a global phenomenon, and has been the cause of concern everywhere in the world, including the developed nations. Quarrying activity is an important activity because it provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles. However, like many other man-made activities, quarrying activities cause significant impact on the environment (Okafor, 2006). In particular, it is often necessary to blast rocks with explosives in order to extract material for processing but this method of extraction gives rise to noise pollution, air pollution, damage to biodiversity and habitat destruction.

One of the biggest negative impacts of quarrying on the environment is the damage to biodiversity (Anand, 2006). Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro-organisms. Biodiversity conservation is important as all species are interlinked, even if this is not immediately visible or even known, and our survival depends on this fine balance that exists within nature (Anand, 2006).

Quarrying activity has the potential of destroying habitats and the species they support (Mabogunje, 2008). Even if the habitats are not directly removed by excavation, they can be indirectly affected and damaged by environmental impacts such as changes to

ground water or surface water that causes some habitats to dry out or others to become flooded. Even noise pollution can have a significant impact on some species and affect their successful reproduction. Nevertheless, with careful planning and management, it is possible to minimize the effect on biodiversity and in fact, quarries can also provide a good opportunity to create new habitats or to restore existing ones (Tanko, 2007).

Many other man-made activities including quarrying involve the production of significant amounts of waste. Some types of quarries do not produce large amounts of permanent waste, such as sand and gravel quarries, whereas others will produce significant amounts of waste material such as clay and silt (Wang, 2007). However, there is still potential for damage to the environment particularly with water contamination. Plants are major components of the ecosystem – a complex interaction between the biotic and a biotic entity of the environment. The activity discharges dust that settles not only on land, plants and trees but also on surface waters used for drinking and other domestic chores.

For thousands of years man has used stone for building, whether it was for monuments, religious buildings or houses. Early on, when Britain was only sparsely populated, man's use of stone and his primitive quarrying would have had little lasting impact on the environment. Gradually, as time went on, more stone was used in building. It was a good material with which to build castles, walls, churches and important buildings since it was strong and weather resistant. As the demand for stone grew, so did the demand for quarrying. During the Industrial Revolution demand soared. The Victorians used stone for all their major buildings and with better

transport and new technology they were able to meet these increasing demands, probably with little thought as to their impact on the environment.

The only countries which have made efforts to control the undesired impacts of mining are those with relatively high per capita income, and low population density. Many poorer countries (Kenya being one of them), in which the primary mining industries are proportionately of greater economic importance than in other countries are understandably reluctant to place non-essential restrictions upon their main earners of wealth and foreign exchange (Warhurst, 1999). He stated that most international firms locate their production activities where they can easily externalize the environmental damage cost of their production that is developing countries where environmental regulation are either limited or poorly enforced. The most controversial problems of mineral development in developing countries have to do with their relation to the developed countries as providers of capital and technology.

In India quarrying has affected many of the people working in the mining industry. According to Azad and Ashish, (2006) stone quarrying and crushing has been known as a highly hazardous work whereby workers are affected by many debilitating occupational health hazards and diseases. Mostly the migrant workers are engaged in this highly unorganized industry. The most common exposure is from silica dust, which causes Silicosis among the exposed workers. Silicosis is a disabling, nonreversible and sometimes fatal lung disease caused by overexposure to respirable crystalline silica. Silica is the second most common mineral in the earth's crust and is a major component of sand, rock, and mineral ores.

Overexposure to dust that contains microscopic particles of crystalline silica can cause scar tissue to form in the lungs, which reduces the lungs' ability to extract oxygen from the air. In addition to silicosis, inhalation of crystalline silica particles has been associated with other diseases, such as bronchitis and tuberculosis. Some studies also indicate an association with lung cancer. There is no cure for the disease, but it is 100 percent preventable if employers, workers, and health professionals work together to reduce exposures by using proper protective gear. The other health hazards could be due to noise pollution, heavy manual labour, minor or major injuries and accidents at workplace, and long working hours. Lack of basic sanitation facilities, drinking water, and shelter add to aggravation of the bad working conditions (Azad and Ashish 2006).

Both the operations of quarrying and crushing being a hazardous to environment as well as to human beings, they require continuous monitoring of the work place as well as the workers. Mining operations cause deforestation, loss of vegetation, soil erosion, ground water level changes and pollution, which can lead to an ecological imbalance. In some cases development has taken the front seat and the implications of the development process are not considered. Development requires the utilization of available resources but it does not check the effects of resource utilization to the environment (Oyaigheviven, 1998). The reason why there have been many environmental problems associated with resource extraction as in the case of quarrying, is that most quarrying activities lack environmental considerations in the planning and building of the major project.

According to Ayodele and Lameed (2010) projects are usually sited for and embarked upon to satisfy the social and economic needs of the company without the need and

aspiration of the people that are directly concerned at the nearest neighboring communities as well as the impact on the primary environment. In open cast mining and quarrying environment, vast area of land are usually existing, leaving behind stagnant ponds or open pits.

In Kenya with the construction of Thika Super Highway, the company in charge of constructing the road has started several quarries along the Eastern bypass which are causing a lot of air pollution. The company is only concerned about their project and does not take into consideration the welfare of the people living close to the quarries. The people living close to the quarries are also affected by the activities that go on in that area. (Azad and Ashish 2006) In Pali Village in India, the safety of human beings is not put into consideration. There is no personal protective equipment being provided to the workers, helmets, safety belts, masks, safety shoes are foreign things (Azad and Ashish 2006).

It is alleged that approximately 200 have been buried alive in this area during the mine blasting operation in the past decade only. The worker and their families who are residing close to these units are more vulnerable to the silica exposure. The children, the women and elderly all are breathing this toxin day and night. According to Irin Africa (2003) the uncontrolled expansion of quarrying in Senegal has led to coastal erosion, a reduction in the area of available farmland and skin and lung problems for the quarry workers and people who live nearby. The effects have forced the government of the day to stop issuing more permits to the people who want to engage in the quarrying activities in the affected areas within the country.

According to Aigbedion, (2005) a large amount of dust from the cement factories and mining operations in the Nigerian limestone quarries are discharged daily into the air. Similarly a lot of air-borne particulate matters are generated by the numerous stone crushing industries in the country (Aigbedion, 2005; Ngongolo and Mtoka, 2013). When the air is laden with such dust, it causes health hazards for some people (Ngongolo and Mtoka, 2013). For example, pollution studies around Sagamu and Ewekoro cement works in Ogun State have shown that several people are suffering from eye pain, and asthmatic attack due to the dust-laden air that prevails within a few kilometers radius of the factories.

Varying degrees of pollution of air, water and land occur in the course of mineral development depending on the stage and scale of activities attained. While only minor pollution occurs during mineral exploration, more intense air and water pollution emanates from the exploitation stages, particularly if carried out on a large scale. In Nigeria, the greatest pollution effect comes from a large scale exploitation of petroleum, limestone and rocks used in the construction works (Unesco-Mab, 1995). A common negative effect of quarrying minerals from the earth's surface is the destruction of its natural landscape, creating open space in the ground and generating heaps of rock wastes that cannot be easily disposed off. These phenomena are amply demonstrated in several parts of place.

2.4.2 Environmental Effects of Gravel Quarry Activities

The environmental impact of quarrying includes degradation in the environment, formation of land slide, loss of natural habitat, and in addition unwanted substance in the soil groundwater and surface water by chemicals from quarrying processes.

Besides creating environmental destruction, the contamination resulting from leakage of chemicals also affects the health of the local population. Mining companies in some countries are required to follow environmental and rehabilitation codes, ensuring the area mined is returned close to its original state. Some mining methods may have significant environmental and public health effects. Nuss and Eckelman (2014) provide an overview of the life-cycle wide environmental impacts of metal production associated with 62 metals in year 2008. The awareness of the community is death due land slide which may be caused by vibration, coughing and chest diseases, pollution, this is addition of unwanted substance on the atmosphere such carbon dioxide also contamination of water source such river water.

2.4.3 Measures to Address The Effects of Quarrying Activity on the Environment

According to Brightmore, (2016) Closing illegal and unregulated quarrying in the context with enforcing regulations and maintaining steadfast legislation regarding to a quarrying behavior and process, strict and swift closing of illegal quarrying activities will set an environmental precedent. Also scrap and recycling, better legislation and regulation. Improving environmental perforce, closing and reclaiming sites of shut down mines. The danger of allowing no longer working to mines exist can not only allowing wasted debris opportunity to and decay on site, but it can lead to illegal environment, a seemingly simple but rarely prioritized activity, replenishing mine site environments is on the key factors to not only earning the respect and cooperation of those living near the quarrying area but will ultimately protect the quarrying impacts of the environment.

2.5 Review of Policies

2.5.1 The National Environmental Policy of 1997

The National Environmental Policy (NEP) is the major policy document which outlines environmental problems and gives guidance to environmental management and protection in Tanzania. The policy seeks to promote the economy and livelihoods of people while promoting sustainable utilization of natural resources in the country. The policy provides the framework for the formulation of plans, programmes and guidelines for the achievement of sustainable development. Key objectives of this policy are to: ensure sustainability, security and equity in the use of resources; prevent and control degradation of life supporting land, water, vegetation and air; and conserve and enhance natural and man-made heritage. The policy promotes the use of EIA's as a planning tool that integrates environmental issues into the planning process. The policy also stipulates the use of numerous approaches in environmental management in Tanzania. NEP relate to quarrying activities because it is a tool of assessing various environmental project with their impacts.(NEP 1997).

2.5.2 Environmental Management Act of 2004

The Environmental Management Act provides a legal and institutional framework for the sustainable management of the environment. It outlines the principles for management, impact and risk assessments, the prevention and control of pollution, waste management, environmental quality standards, public participation, compliance and enforcement. It provides the basis for the implementation of international instruments on the environment and the National Environmental Policy. All project activities must be planned in order to comply with the provisions of Part VI (EIA)

Studies, Part VIII (Pollution Prevention and Control), Part IX (Waste Management), Part X (Environmental Quality Standards) and Part XI. Specifically, section 81(1) EMA 2004 states that each developer has to carry out an Environmental Impact Assessment (EIA). Environmental Management relates to quarrying works because quarrying is conducted in the environment (EMA 2004).

2.5.3 Occupational Health and Safety Act No. 5 of 2003

This act makes provisions for safety, health and welfare for persons at work in factories and other places of work; to provide for the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with activities of persons at work. Proposed road rehabilitation and upgrading operations will entail the employment of both skilled and unskilled laborers, and as such will comply with this Act. Occupational health and safety are key aspects in the operations. First aid and appropriate personal protective equipment will be provided to employees and maintained by the contractor during the period of construction. The quarry owners need to adhere with the Occupation Act No. 5 of 2003 by making sure that all the requirements stipulated in the Act are followed (URT, 2003).

2.5.4 Mineral Policy of 2009

Mining activities cause adverse effects to safety and occupational health of the mineworkers as well as environmental land degradation, pollution, and social disruption to local communities around mine sites. However, improved management systems for health safety and environment have dramatically increased safety and environmental performance in mining operations over last decade. To ensure

sustainable mining activities, there is a need for the Government to strengthen monitoring and regulation of mining industry to reduce or eliminate the adverse effects on health and safety environment and social issues. It is also important for the Government to make efforts to increase environmental awareness and promote environmentally friendly practices in the mining industry, particularly among small scale miners(Mineral Policy of URT 2009).

2.6 Conceptual framework

In Figure 2.1 shows the environmental and health impacts of gravel quarrying activities. The environmental impact of mining includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. Some mining methods may have significant environmental and public health effects. In quarrying activities they run the risk of serious physical injuries while handling heavy equipment or moving materials around. Dust from the mine site are dangerous for their respiratory systems, this danger is greatest in mining areas. Also if miners are working in deep mines, there is always the danger of getting trapped there due to collapse of a tunnel. No matter how low the chances, this thought will play in their minds when they go into work. It adds mental stress. Miners generally live around the mine site with their families. The mine spoils dumped can affect their quality of life, with water related diseases being the greatest risk.

Gravel quarrying activities requires the clearing of large parts of land. Often, the area is completely deforested. Along with deforestation, mining activities require

transportation facilities; construction of roads can cause serious habitat fragmentation. The noise caused by mining activities contributes to immense noise pollution in the vicinity. Dust coming from mine sites can cause air pollution, water pollution, and land pollution. The dust from mine sites can seriously affect vegetation around the area by coating the leaves and preventing exchange of air, the plants can even be suffocated to death due to this.

Open-cast mining is more dangerous to the environment than deep mining, because huge amounts of land and soil are excavated and this causes loss of precious soil. Land degradation goes hand in hand with mining, because the land used cannot be used for anything else for many years to come. The waste products of mines (called mine spoils) are simply dumped in a place nearby. These spoils are often toxic and can cause serious pollution, groundwater contamination, kill soil organisms, cause biomagnification, etc.

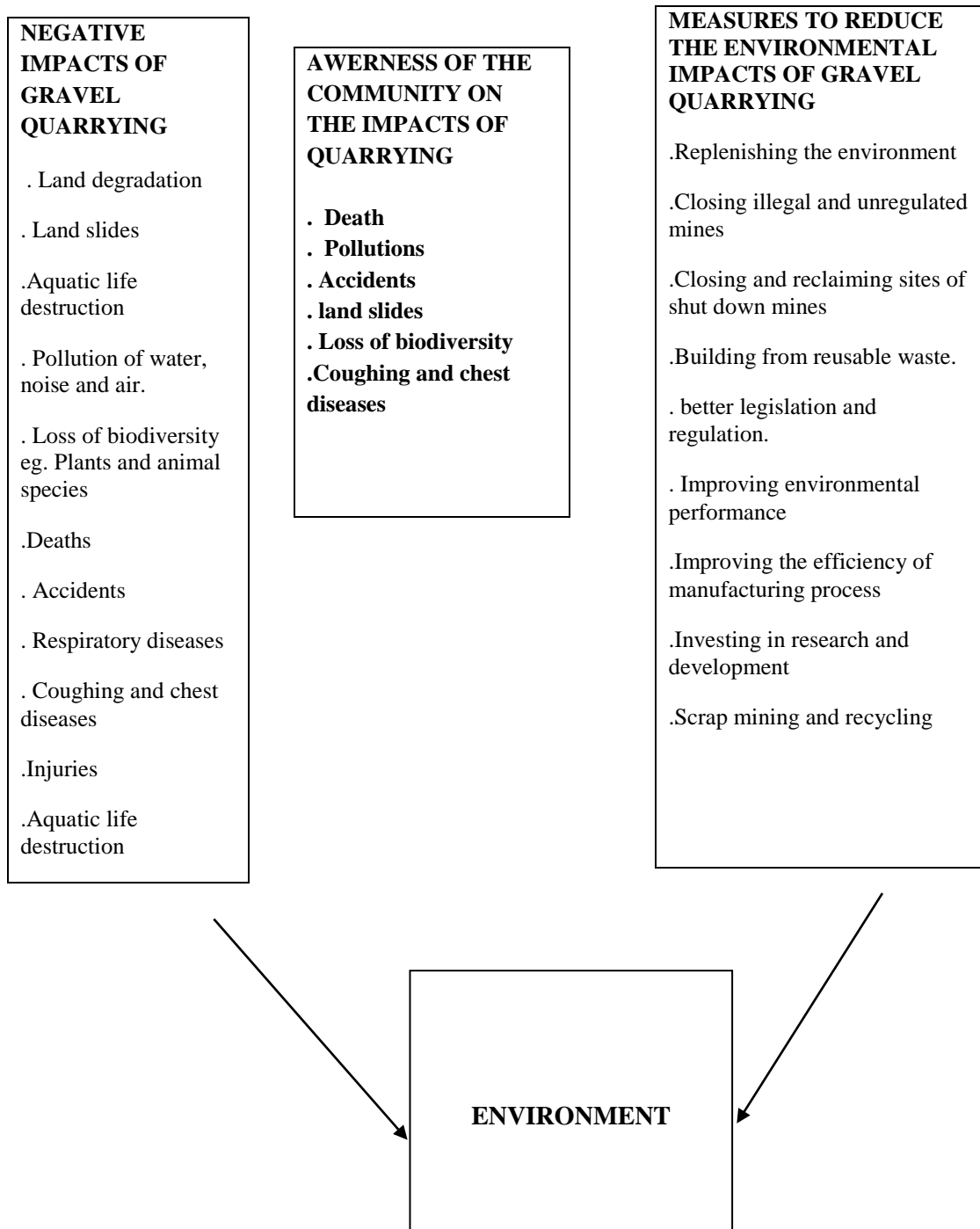


Figure 2.1: Assessment of the Effects Quarrying Activities on the Environment

Source: Adopted from Eshiwani (2014)

2.7 Knowledge gap

Several studies have been conducted focusing on the effects of quarrying activities on the environment (Nene, 2011). One of the biggest negative impacts of quarrying activities on the environment is damage to biodiversity (Anand, 2006). Biodiversity essentially refers to the range of living species including insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro organism. In a simple definition biodiversity can be defines as the varieties of living organisms and their surrounding environments or ecosystem (URT, 2014; URT, 2015). This includes species which are living in terrestrial ecosystems, marine ecosystems and the like. The country, Tanzania hosts terrestrial, coastal and marine and inland water (lakes, rivers, streams, dams and wetlands) ecosystems (URT, 2015). Also in various research that have done, there is no any one that has state the ways forward on reducing land degradation around quarry sites which can help the conservation of biodiversity. Therefore, this study is designed to fill this knowledge gap.

2.8 Chapter summary

This chapter analyzed introduction on literature review including the definition of the frequently used terms such as empirical review that shows various studies conducted in different places that indicates the effects of quarry activities to the environment. This chapter used two theories; the Von Thunen and urban sprawl theory which is among the cited theory in this study which deals with agricultural activities closer to the urban areas can be applied in quarry activities whereby the demand for gravel, stones and sand to the city or nearby urban centres is one of decreasing intensity with distance from the city. Basing on this theory the study analyzed the problem of urban expansion which facilitates people from Lengijave village to utilize land within their village and degrade their area hence contribute to the loss of biodiversity. Another theory used in this study is the system theory. This theory emphasizes that the real systems are open to and interact with anybody including their surrounding environment and that they can acquire qualitatively new properties through emergence resulting in continual evaluation. The system theory conceptualizes land degradation and negative impacts of social and economic as the response of the quarrying to the demand of the environment. Land degradation includes negative effects such as loss of in vegetation cover, changes in the landscape and ecosystem services. Father more the chapter reveal the conceptual framework which shows the impacts of quarry activities to our environments despite the fact that people in the urban areas are highly depending on gravel for building their house not only that but also the in road construction, wells construction to mention but a few.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the study area and deals with the approaches used in data collection and analysis of the information collected for this study. The chapter describes the study area, research design, study population and sampling procedure. It further focuses on the data collection methods, data analysis, interpretation and presentation, validity and reliability of the research instruments and ethical issues.

3.2 Research design

The study adopted the descriptive research design. According to Mugenda and Mugenda (1999), descriptive research design is useful as it helps to obtain information that describes the existing phenomena by asking individuals about their perceptions, attitudes and values. The design used to explain the existence of two or more variables at a given point. Furthermore, descriptive research design reports things the way they are. In this regard, the descriptive research design used so as to achieve the main objective of the study which to assess the environmental impacts of gravel quarrying at Lengijave Village in Arusha District. The study combined both qualitative and quantitative research approaches.

3.3 The Study Area

Lengijave Village is found at the foot of Mountain Meru in Olkokola Ward, Arusha Rural District (3.2997 S 36.6526 E), in Arusha Region along Namanga and Nairobi road just 21 kilometers from Arusha City. Geographically, it is in the northern part of Tanzania and its climate is partly tropical. It has a total population of 11,294 people according to (NBS, 2012; Agwanda, 2014). The main economic activity before engaging in extraction of gravel was agriculture which involves livestock keeping and cultivation of crops mostly food crops. Livestock keeping is done through free range system and only fewer adopted zero grazing (Chibunda, 2009). Due to the adverse impacts of climate change, people have adapted by engaging themselves in other economic activities, such as the extraction of gravel, which later resulted to environmental impact that this study aims to investigate.

3.4 Target population

Population is a set of elements that the research focuses on and to which results obtained by testing the sample can be generalized (Bless and Higson –Smith, 1995; Sebstar et al., 2006). The target population of this study are workers in quarrying site, heads of household and village executive officer in the study area. The sample size of this study was 78 respondents from selected village of Lengijave with population about 1705.

3.5 Sampling procedures

According to Sweeney and Williams (2002), a sample is a small group of respondents drawn from a population that the study is interested in obtaining the information.

Sampling is a procedure used to identify people, place or things to study. Sampling procedure ensured maximum coverage of population for the study. However, due to inadequacy of resources specifically time and finance it was not possible to study the whole population. Therefore sampling was necessary. The following sampling techniques were used to select samples.

3.5.1 Purposive sampling

Kombo and Tromp (2006) defined purposive sampling as “a sampling technique with which the researcher purposely targets a group of people believed to be reliable for the study,, The technique is less costly, very convenient and guarantees inclusion of the relevant elements in the sample. Purposive sampling was used to select Village Executive Officer (VEO) and the Lengijave village elders who lived in the study area for a long time.

3.5.2 Simple random sampling

A simple random sampling techniques is a technique which give population an equal chance for all miner in the village to be included in the sample (Robson, 2011; Vaske, 2008; Kothari, 2004). The simple randomly sampling is probability sampling technique which is used in selecting miners from the list of miners obtained from village office. Simple random sampling was used to select the respondents who were involved in this study. The techniques was suitable as it gave each member an equal chance of being involved in this study.

3.6 Sampling frame and sample size

A sample is small representative of the whole population (Miller 1991). Kamuzora *et al.* (2008) defined sample size as exactly number of items selected from a population of constitutes a sample. Studying the whole population was not easier as far as financial situation concern. Therefore the sample size for this study was 78 respondents from the population of 1705.

3.7 Sources of data

In this study both primary and secondary data were collected. Primary data was the information regarded as original, collected in the field. Primary data have been collected using questionnaires, interviews of key informants and observation. The secondary data sources were obtained from reports, published and unpublished material from difference sources. Secondary data will be collected in the library and in the websites.

3.8 Data collection methods

3.8.1 Questionnaires

Face-to-face structured and semi-structured questionnaires were administered in the Lengijave village selected village. The household questionnaire contained aspects such as: socioeconomic characteristics of households; potential issues and problems related to gravels quarrying, employment and/or revenues. The interview with the head of household or the representative who knows well the household information was conducted in the selected household's residential area.

3.8.2 Interviews with key informants

Face to face interview with key respondents was designed and guided by structured and semi structured questionnaire which administered to the Village elders and Village Executive Officer. The selection of interviewee based on their importance as selected officials, occupation, roles, age, position within the community and scope of knowledge concerning the village history and current activities conducted in the village (Kaswamila, 2004).

3.8.3 Focus group discussion

Focus group discussion is defined as the group of individuals selected and assembled by a researcher in collaboration with the area leaders to discuss and comment on the subject matter of the researcher based on the personal experience. This was used collect data from different age different groups which included the youth, elders and adults. The research for choosing these group were to get different views from different age groups. Various idea from each participant under discussion helped the researcher to get pertinent information for the study.

Also FGD was used to compliment, supplement and verifying data collected, by other methods and each FGD composed of seven people as this was easily manageable by the researcher. Also, the number was within the range suggested by Wills (2002) who contend that the appropriate size for focus group discussion range between 6 and 12 people based on their sex and age for easy manageability of the discussion. The researcher facilitated FGD by addressing issues relevant to the research among which

include awareness of gravel quarrying effect in the study area and measures to be taken to mitigate the problem. In this exercise the researcher acted as a facilitator.

3.8.4 Observations

Observation is a systematic data collection approach. Researchers use all senses to examine people in a natural setting or naturally occurring situations. This method will assist in soliciting biophysical information and proving information gathered from interviews and household survey. It will include observation on the ecological impacts of gravel quarrying in the study area.

3.8.5 Documentary literature review

Documentary review, involves deriving information by carefully studying written documents, or visual information from sources called documents. This could be either public documents or personal documents such as textbooks, newspaper, articles and speeches (Hessler, 1992). In this study, secondary data were collected through the review of a range of literature related to this study, found at the OUT library including text books, journals, articles and newspapers, and other information was obtained from the district office website and other internet sources.

3.9 Data analysis, interpretation and presentation

Data analysis means to recognize, provide structure and elicit meaning. According to Rwegoshora (2006), data analysis involves the ordering data into constituent parts in order to obtain an answer to the research question. Qualitative data was analyzed by using content analysis. Content analysis means analyzing the content of an interview

in order to identify the main themes that emerge from respondents (Kumar, 2005). Content analysis is one the classical procedure for analyzing textual material range media product to interview data on this essential feature is the use of categories which are often derived from theoretical models (Flick. 2006). In this study content analysis will be collected through interview and closed ended questioners.

3.10 Validity and reliability of the research instruments

3.10.1 Validity

Validity refers to the extent to which data collection methods accurately measure or the extent to which research findings are really about what they prefers to be (Saunder *et al.* 2007). Validity determines whether the research truly measures that which it was intended to measure or how truthful the research result are. It refers to whether the means of measurement are accurate and whether they are actually measuring what they intended to measure. In this regard, different method of data collection were used. For instance, the use of triangulation helped to demonstrate validity and opened up new perspective about topic under investigation.

3.10.2 Reliability

Joppe (2000) defined reliability as the extent to which the results are consistent over a time and an accurate representation of the total population under the study. If the results of study can be reproduced under a similar methodology, the research instrument is considered to be reliable. This refers to the consistence with which repeated measures produce the same results across time and across observer, (Patton, 2002). Pilot study was done and any correction or adjustments was made accordingly

in relation to the topic under study. The results of the pilot study were not included in the final research findings. In this study, correlation coefficients between the two sets of results were calculated. Only reliability coefficients of 0.7 and above were accepted. To ensure reliability methods for data collection and analysis, pre testing was conducted to ten (10) respondents before actual data collection.

3.11 Ethical considerations

The study strictly observed ethical standards and principles of social science research in order to protect the participants from psychological, physical and emotional harms by ensuring their privacy, secrecy and confidentiality of their information. The study was conducted under informed consent of the participants by informing them the purpose of the study to influence their choice to participate. The researcher informed the participants about confidentiality of the information given. Also the researcher ensured the respondents participated in the study willingly, readily and voluntarily. Lastly, the researcher ensured the respondents that, no any intervene or interfere with the performance of the respondents as far as all the interviews were conducted at the working place and all the questionnaires filled and collected at the working places of the respondents and at convenient times as proposed by the respondents.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings of the study, data analysis and discussion of the findings. The findings are presented using simple statistical methods like simple frequencies and percentages presented in tables and figures. These findings are according to the research objectives as well as research questions that guided the study. The findings presented in this chapter give information about the environmental effects of gravel quarry activities on the study area, local community awareness of the effects of quarrying of gravel on the environment and measures to address the effects of gravel quarrying on the environment. Thematic approach to presentation of findings was adopted in this study. The presentation therefore was according to themes.

4.2 Background Information about the Sample

This study included in its sample people with varying backgrounds and characteristics. Table 4.1 and Table 4.2, Table 4.3, Table 4.4. and Table 4.5 presents the background information and characteristics of the sample.

Table 4.1: Respondent's Composition by Gender

Sex	Respondents	Percentage
Male	48	62
Female	30	38
Total	78	100

Source: Field Data, 2018

Results on the research respondent's composition by gender are shown in Table 4.1 which shows that there were variation in terms of gender among the respondents. The findings further shows that, male respondent's participated more than female as they formed 62% of respondents. Female respondents formed 38%.

Table 4.2: Respondent's Composition by Age Group

Age categories	Respondents	Percentages
20-25	3	04
26-30	10	13
31-35	18	23
36-40	15	19
41-45	16	16
51+	12	12
Total	78	100

Source: Field Data, 2018

Findings in Table 4.2 indicated that, there were variations in terms of age groups among the respondents. The findings shows that respondents of the age group between 31 - 35 participated more as they formed 23% of the total respondents. This was followed by those with age group between 36 - 40 as they formed 19%. Those with age range between 41-45 formed 16% followed by those with age range of 26-30 as they formed 13%. Respondents with age range above 51 formed 12%. Only 4% composed of respondents with the age range of 20-25. The result revealed that the majority of the people in the study area were in the category of the young and middle-aged population.

Table 4.3: Respondent's Composition by Marital Status

Marital status	Responses	Percentages
Married	57	73
Divorced	2	2
Single	9	12
Widowed	10	13
Total	78	100

Source: Field Data, 2018

In table 4.3 above, the findings indicated that the married respondents participated more than those who had other marital statuses as they formed 73%. This was followed by the widowed as they formed 13%. Single participants formed 12%. Only 2% were divorced. The findings revealed that, most of the respondents had some family obligations that is why they were engaged in gravel quarrying activities to meet family needs.

Table 4.4: Respondent's Composition by Level of Education the Respondents

Education level	Responses	Percentages
Primary education level	45	58
Secondary education level	18	23
Tertiary education	15	19
Total	78	100

Source: Field Data, 2018

Findings in Table 4.4 revealed that about 58 % of the respondents had primary education, 23.07% had secondary education and 19.2% of the respondents had tertiary education. Given the fact that I come from this area more respondents in Arusha District Council have a low level of education. Thus, the destruction of environment is caused by residents of this area who low level of education and had no other means

to run their life instead of extraction of gravel quarrying due to lack of other economic activities to generate the income.

Table 4.5: Respondent's Composition by Occupation

Occupation	Respondents	Percentages
Agriculture (farming and livestock)	35	44.8
Business	25	32.2
Employment	18	23
Total	78	100

Source: Field data, 2018

Findings in Table 4.5 indicated that, 44.8% of respondents were engaged in farming and animal keeping, 32.2% of the respondents were engaged in business while 23% of the respondents were civil servants. This study found that those who were engaged in agriculture were practiced local faming and livestock keeping which were not enough to satisfy their livelihood. Those who dealt with business, had small businesses which were not enough to meet their living expenses hence they depended on gravel quarrying activities to meet family needs.

4.2 The Environmental Effects of Gravel Quarry Activities

The findings in this study revealed that there were varying views on the effects of gravel quarry at Lengijave village. Table 4.6, Plates 4.1, 4.2, Table 4.3 and the respective narratives give an expression on the effect of gravel quarry at Lengijave village.

Table 4.6: Land Degradation is the Effects Resulting from Quarry Activities

Effects of gravel quarry Activities	Respondents	Percentage
Soil erosion	10	13
Land degradation	35	49
Air pollution	5	2
Loss of natural landscape	28	36
Total	78	100

Source: Field data, 2018

Findings in Table 4.6 indicated that, land degradation is the major effect resulting from quarrying activities. This was supported by 49% of the respondent. This was followed by loss of natural landscape which formed 36%. Soil erosion formed 13% while air pollution formed 2% of the total effect.

These findings provide an evidence of the existing effects of gravel quarry activities at Lengijave village. This is probably due to the fact that, people of Lengijave village depended gravel quarry Activities as their source of income despite of having other activities. This was supported by the observation done by the researcher in the study area as shown in Plates 4.1, 4.2 and 4.3.



Plate 4.1: Quarry Activities at Lengijave Village

Source: Field survey, 2018



Plate 4.2: Land Degradation at Lengijave Village

Source: Field survey, 2018



Plate 4.3: Land Degradation at Lengijave Village

Source: Field survey, 2018

In the interview, one of the respondent said:

Quarrying activities has an effect on the environment. Quarries leaves a lot of pot holes on the earth surface and some of the quarries have been difficulty to reclaim the land which have been used for quarrying and make it productive again as it was before. This process destroys the beauty of the land area permanently making it uneconomical. Most of the quarries are not fenced and this posed a danger to the people living close to the quarrying area as in some case cattle fall in the pit which is left after extraction of gravel (November 2019).

Another interviewee said;

As you can see for yourself, things there are not okay. I'm trying to think whether some generation to come will find anything in this area than these pits. The problem is that even some leaders in this area are doing these activities hence prohibiting to others becomes impossible but for sure there is a problem (November 2019).

4.4 Local Community Awareness on the Effects of Quarrying of Gravel on The Environment

The findings in this study revealed that there were varying community perceptions regarding the awareness on the effects of quarrying of gravel on the environment in their area. Tables 4.7, and 4.8 and the respective narratives below present these community perceptions.

Table 4.7: Respondents Views on whether or not they are aware the Effects of Quarrying of Gravel on the Environment in the Study Area

Response	Respondents	Percentage
Yes	65	83
No	10	17
Total	78	100

Source: Field data, 2018

Findings in Table 4.7 indicated that respondents had different views on whether or not they are aware of the effects of quarrying of gravel on the environment in the study area. The majority of respondents were aware of the effect of quarrying of gravel on the environment in the study area as they formed 83% while 13% of respondents did not know the effect of quarrying of gravel on the environment in the study area. The findings gives an expression that, respondents are aware of the effects of quarrying of gravel on the environment at Lengijave village.

In the interview, one of the respondent said:

Off course I know the effects, I'm sure all of us here knows the effects but what should we do? Remember we depend on these activities to get some money for

our living. Sometimes we feel bad when we destroy the environment between have no option. (November 2019).

Table 4.8: Respondents Views on whether or not they are affected from Quarrying of Gravel in their Area

Response	Respondents	Percentage
Yes	42	54
No	36	46
Total	78	100

Source: Field data, 2018

Table 4.8 above revealed that respondents differed in opinions on whether or not they are affected from the quarrying of gravel in their area. The majority of respondents agreed that they are affected from quarrying activities in the study areas as they formed 54% of the total respondents. 46% had an opposing view. These findings confirm that, despite the fact that the quarrying activities at Lengijave village are the source of most of the household income, they are affected from those activities.

Respondents were asked to mention some effects of the quarrying activities in the study area, the following were some of their answers;

- (i) Environmental degradation
- (ii) The dust from the quarrying affects our health
- (iii) During rainy season the pits becomes the home of mosquitos
- (iv) The pits are dangerous to our kids
- (v) Sometimes the robbers and thieves hide in the pits
- (vi) Destruction of the beauty landscape

4.5 Measures to Address the Effects of Gravel Quarrying on the Environment

Findings revealed that, respondents had different views on the measures to be taken in addressing the effects of gravel quarrying on the environment at Lengijave village. Tables 4.9, Table 4.10, and 4.11 and the narratives below provide the respondents views on the measures to be taken in addressing the effects of gravel quarrying on the environment at Lengijave village.

Table 4.9: Respondents Views on whether or not the Problem Quarrying of Gravel on the Environment can be Solved

Response	Respondents	Percentage
Yes	69	88
No	9	12
Total	78	100

Source: Field data, 2018

Table 4.9 above indicated that respondents had different views on whether or not the problem quarrying of gravel on the environment can be solved. The majority of respondent's believed that the problem can be solved as they formed 88%. while only 12% of the respondents had a different view. The findings indicate that, the majority of respondents are aware of the effects that is caused by the quarrying activities in their area and that the problem can be solved.

In the interview, one of the interviewee said;

Solving this problem is very possible only when people here will have an alternative thing to do and also if they're given enough

education on how to preserve the environment. Without doing so my friend nothing will be done for sure.(November 2019)

Table 4.10: Respondents Views on whether or not they are aware of the Laws of Mineral Mining

Response	Respondents	Percentage
Yes	27	35
No	51	65
Total	78	100

Source: Field data, 2018

Findings in Table 4.10 revealed that the majority of respondents did not know the laws of mineral mining despite of doing mining for years as they formed 65%. Only 35% had a view that they know the laws. This gives an expression that the mining laws are not known to the majority in Lengijave village hence destruction of environment can continue. Respondents were asked to choose the best measure in addressing the problem in their area as shown in Table 4.11.

Table 4.11: Respondents Views on the best Measures to Address the Effects of Gravel Quarrying on the Environment

Response	Respondents	Percentage
Stop Selling	7	8
Educating People	27	34
Reporting to Mining Management	11	14
Introducing other Activities	19	24
Use Mineral Rule & Regulation	14	20
Total	78	100

Source: Field data, 2018

Findings in Table 4.11 revealed that there were various measure to address the effects of gravel quarrying on the environment at Lengijave village. The majority of respondents had a view that education is the best measure in addressing the effects of gravel quarrying on the environment in the study area as they formed 34%. This was followed by introducing other activities in the study area as the alternative activities for Lengijave villagers as they formed 24%. 20% of the total population believed that the best measure is the use mineral rules and regulations. Those who believed that reporting to mining management was the best measure formed 14%. Only 8% believed that the best solution is to stop selling the gravel. The findings gives an expression that there are myriads of measures to address the effects of gravel quarrying on the environment at Lengijave village.

4.6 Discussion of the Findings

4.6.1 Environmental effects of Gravel Quarry Activities on the Study Area

Results about environmental effects of gravel quarry activities on the study area revealed that land degradation is the major effect resulting from quarrying activities. This was supported by Irin (2003) who showed that, the uncontrolled expansion of quarrying in Senegal has led to land degradation, coastal erosion, a reduction in the area of available farmland and skin and lung problems for the quarry workers and people who live nearby. The effects have forced the government of the day to stop issuing more permits to the people who want to engage in the quarrying activities in the affected areas within the country. Ozcan, Seker and Musaoglu (2012) whose study confirmed that;

Quarrying basically destroys landscape. This can lead to downstream movement, scouring, or accumulation of sediment

while provoking shoreline erosion. When riverbeds are composed of sand, this on-going pattern of erosion and deposition causes meanders to progress slowly downstream in time (P.12)

Findings also revealed that gravel quarry activities on the study area destroyed the natural landscape and soil erosion. These findings correlated to the findings from Environmental Report (2013) which indicated that, land degradation is one of the significant impacts arising out of mining and quarrying activity which is mainly in the form of alteration of land structure due to excavation, stacking of top soil and loss of land due to dumping of mine waste and overburden soil. Stone and sand quarrying causes damage to property, depletion of ground water, loss of fertile top soil, degradation of forest land, adverse effect on the aquatic biodiversity and public health.

From the findings and the literatures above it can be concluded that gravel mining have a considerable impact on land, water and biological resource if the operation and post operation issues are not handled properly.

4.6.2 Local Community Awareness on the effects of Quarrying of Gravel on the Environment

Findings indicated that the majority of respondents were aware of the effect of quarrying of gravel on the environment in the study area. This is due to the fact that there are a lot of campaigns on the effects of quarrying of gravel on the environment. Nene (2011) indicated that, in many countries where gravel quarreling activities takes place, there are number of strategies to raise awareness of the communities on the effects of the activities they are doing. That reduces effects to the environment and the health of the community as well as the biodiversity.

Findings also indicated that the community were affected from the effects of quarrying of gravel activities in their area. This is because the safety of human beings is not put into consideration. There is no personal protective equipment being provided to the workers, helmets, safety belts, masks, safety shoes are foreign things. It is alleged that approximately 200 have been buried alive in this area during the mine blasting operation in the past decade only. The worker and their families who are residing close to these units are more vulnerable to the silica exposure. The children, the women and elderly all are breathing this toxin day and night (Azad and Ashish, 2006).

4.6.3 Measures to Address the Effects of Gravel Quarrying on the Environment

Findings revealed many measures on how to address the effects of gravel quarrying on the environment. The findings further revealed that respondents had a view that the problem of gravel quarrying on the environment can be solved. The findings suggested different measures to be used in addressing the effects of gravel quarrying on the environment. They mentioned some measures such as stopping selling, educating people, reporting to mining management, introducing other activities and using the mineral rules and regulations. The findings aligns with the Ayodele and Lameed (2010) findings which found that closing illegal and unregulated quarrying in the context with enforcing regulations and maintaining steadfast legislation regarding to a quarrying behavior and process, strict and swift closing of illegal quarrying activities will set an environmental precedent. Also scrap and recycling, better

legislation and regulation. Improving environmental performance, closing and reclaiming sites of shut down mines.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

. This chapter presents summary of the findings, conclusion and recommendations.

5.2 Summary

This study focused on the assessment of the effects of quarrying activities on the environment in Lengijave Village at Arusha District Council, Tanzania. The main objective of this study was to assess the effects of quarrying activities on environment in Lengijave Village in Arusha District Council. The first specific objective of this study was to identify the environmental effect of gravel quarry activities on the study area. The findings revealed that, the most effect of gravel extraction in the area are land degradation due to landslide, damage of landscape and soil erosion. The second objective of this study was to examine local community awareness on the effects of quarrying of the gravel on the environment. The findings show the community were aware of the effects of gravel quarrying on the environment where most of the community declared that gravel quarrying has a great impact on the land and also to human being like death, environment degradation and environment pollution. The third objective of this study was to determine measures to address effects of gravel quarrying on the environment. Measures to reduce or control the effects of gravel quarrying included stopping selling gravel, educating people, reporting to mining management, introducing other activities and using the mineral rules and regulations.

5.3 Conclusion

On the basis of data presentation made in chapter four, the following conclusions were made from this study.

- (i) The study concluded that, gravel quarrying activities in the study area caused serious environmental effects major being the land degradation. These effects had negative impacts to the surrounding community and the biodiversity. If serious measures will not be applied, the environment will be more affected.
- (ii) The study concluded that, the community believe that gravel quarrying is the best way of earning cash that is the reason they were aware with the effects of gravel quarrying activities but still they kept doing. If the community is not well sensitized to do alternative activities, the problem might be worse.
- (iii) It was concluded from the study that, education is the major and an effective mechanism to make sure the community changes their mindset and being part of the environmental conservers than being destroyers of the environment. Other measure can be used to supplement education to the community.

5.4 Recommendations

- (i) The study recommended that, sensitization should be done to the community so that they understand and be part of environmental conservers.
- (ii) The government and other stakeholders through village environmental committees should plan and propose the best measures to reduce the effects of gravel quarrying in the environment. The community should participate in decision making.

- (iii) The community should be given entrepreneurial skills so that they engage in other activities for then to earn income for their families. This will reduce the concentration on the gravel quarrying activities.
- (iv) The government should revoke licenses of that those quarrying owners who do not adhere to the set of laws.

5.5 Future Research

- (i) The study was about the effects of quarrying activities on the environment in Lengijave Village at Arusha District Council. Further research should focus on the effects of quarrying activities on human health.
- (ii) The study focused on Lengijave village only. Further research should focus on other areas because quarrying activities are being done in many areas in Tanzania.

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APPENDICES

Appendix I: Questionnaires for the Heads of Households in Lengijave Villages

Dear Respondent,

I am a postgraduate student of the Open University of Tanzania in the Department Geography pursuing a Master of Natural Resources Assessment and Management. I am conducting a research on the “Assessment of the effects of quarrying activities on Environment in Lengijave Villages”. I am humbly requesting you to take part in this research by giving the required information. Please answer the questions below as honestly as possible. Your responses will be confidential and completely anonymous. Be informed that they are for academic purpose only.

Section A: Perception of local people

1. Village.....Ward.....
2. Gender Male ☐ Female ☐
3. Age: 20-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ 46-50 ☐ 51+ ☐
4. Period of stay in the study area: > 1 ☐ 1-5 ☐ 6-10 ☐ 11<
5. Education Level attained: Primary ☐ Secondary ☐ Tertiary ☐
6. Main occupation.....Marital Status.....
7. How long have stayed in this village?
8. Where did you come from?
9. What is the size of your household?

10. What is the size of your gravel areas (acres?)

B: Gravel Causing problems in the Villages

11. Do you have gravel in this area? Yes/no

If Yes mention them

12. What problems do gravel extraction cause?

Tick the appropriate

Land degradation	
Soil erosion	
Air pollution	
Loss of natural landscape	

13. What are the sources of the problems that you are getting from extraction of gravel?

- a) Price
- b) Land slide
- c) Living close to Protected Area
- d) Flood

14. What season of the year do you experience the above mentioned problems?

- a) dry seasons

b) rain season

15. If it's dry season what are the reason?

16. If it's wet season what are the reason?

B. Local community awareness on the effects of quarrying of gravel on the environment

17. Are you aware on the effect of quarrying of gravel on the environment in this area?

a) Yes () No

18. Are you affected from the quarrying of gravel on the environment?

b) Yes () No ()

Section C: Measures to Minimize Environmental Impacts in the study area

19. Do you think the problem quarrying of gravel on the environment can be solved?

a) Yes () No () Not sure ()

20. Are you aware of the laws of the Mining minerals? Yes ()
No ()

21. How do you mitigate the problems caused by extraction of gravel quarrying in your village?

a) Stop selling

- b) Educating people
- c) Reporting to mining management
- d) Introducing other activities

22. Do you like the Mineral's rules and regulations controlling how you deal with wild animals? Yes () No ()

22. If your answer to 10 is No, explain why?

.....

.....

23. Are there any strategies offered to you on how to deal with Environmental Impacts?

24. If any, how often are they offered?

25. Are they beneficial?

26. How does district management react toward addressing the problems you're encountering from extraction of gravel quarrying?

- a) Very quick
- b) Quick
- c) Moderately
- d) Slowly
- e) No reaction at all

27. How often does your community meet with a staff member to discuss any matter of concern that might arise?

28. Which in your view would be the best way of resolving or minimizing this problem in the area?

D: Opinions/ Suggestion given by Local People about what should be done

29. What are your opinions about the problems you are experiencing from extractions of gravel?

.....

Appendix II: Guide Questions for Focus Group Discussion

Date.....

Name of Institution.....

Position held.....

Sex.....

1. What are problems caused by extraction of gravel?
2. How do you solve problems from extraction of gravel in your village?
3. When did extraction of gravel started in your village?
4. what are the challenges you faced when extracting gravel?
5. How do you rate the cost you get from extraction of gravel in your village?
6. How should the Government help you in managing the problems from extraction in your village?
7. How are you involved in conservation of land in your village?
8. Which area of land causes problems in your village?
9. How do you consider the level of extraction of gravel in your village?
10. What is the population trend in your village?

Appendix III: Guide Questions for Village Executive Officer

Date.....

Position held.....

Sex.....

1. Are there laws of the Land promulgated by the Mining Department to help resolve environmental impacts?
2. If there are there, are there any agencies or organizations you are partnering with in trying to resolve environmental impacts?
3. Did you receive any complaints about land from residents of your community? (i.e. the year 2014/2015)
4. How often do you receive these complaints?
5. How often do you meet with the community to discuss any matter of concern that might
6. Does the community participate in any way possible in the management of land-ecological impacts?
7. Are there any environmental management strategies involved in the mitigation of land degradation impacts?

Appendix IV: Questions used for Key Informants

1. Which method of extracting gravels can causes problems in villages?
2. What type of damage do they cause?
3. In which season of the year are the damages mostly caused in the village?
4. What is the magnitude of damages caused by extraction of gravel in the villages?
5. How many people have been killed by land slide in these village from 2010-2015?
6. How are the villagers affected by the problems which they are getting from extraction of gravel in the villages?
7. What are your suggestions on what should be done to control the land slide not to cause the damages/problems in the village?

Appendix V: Time Schedule

Basing on the course schedule, the duration of this study is proposed to be five months from the date of data collection.

[illegible]

Appendix VI: Proposed Budget

Category	Unit cost	Quantity	Total amount
A4 Paper	6000	20	120,000
Punching machine	25,000	1	25,000
Files	5,000	10	50,000
Stapler	15,000	1	15,000
Staple pins	3000	4	12,000
Document printing	800	500	400,000
Document binding	4000	6	24,000
Sub-total			646,000
Personnel			
Data entry clerk	10,000	35 days	350,000
Statistician	400,000		400,000
Transport	20,000	30 days	600,000
Sub-total			2,642,000
Food	10,000	30 days	300,000
Transport	15,000	30days	450,000
Total			3,392,000
Contingencies 10%			339,200
Grant Total			3,731,200